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ABSTRACT

Seventy-seven multidisciplinary activities for grades K-6 are contained in this revised edition of energy education lessons for Kentucky students. Section I introduces students to the topic of energy by emphasizing human interaction with the environment. It focuses on personal energy, food as the source of human energy, food chains, and the sun as the ultimate source of energy. Section II explores various types of energy sources available for human use and emphasizes renewable sources of energy. Students are encouraged to build and make workable models for demonstration. The last section focuses on ways in which people waste energy and the need to conserve and share limited natural resources. Each activity identifies the concept being taught, subject areas, materials, and procedure. Many indicate adaptations for other disciplines. The booklet is illustrated and contains student worksheets and a bibliography. (Author/DC)

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K.E.E.P.
KENTUCKY'S ENERGY EDUCATION PROGRAM
ACTIVITIES FOR THE CLASSROOM
K - 6

edited by

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and
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paid for by the Kentucky Energy Conservation Plan

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THE ENERGY GAME

SECTION 1: FOREVER AND A DAY . . . . .ENERGY BEGINNINGS

Activities in this section introduce students to the topic of energy by emphasizing human interaction with the environment, ie., what gives humans "personal energy". Human energy is dealt with in both a physical and emotional context. Food is the source of human energy. Our food is obtained from food chains, which is nature's way of transferring energy from one organism to another.

the activities then progress to emphasize that the ultimate source of energy shich powers the food chain is the sun. The sun's energy is evident in other forms, such as fossil fuels (oil, coal, and natural gas), wood, water and wind.

HUMAN ENERGY

1

ACTIVITY:

1) Do a short series of physical exercises: walk, hop, skip, jog, and run a measured distance. Ask the children to determine which method of movement requires the most work and tell why. Be sure to explain "body power".

2) Have students act out different ways they use body power. (Be sure that students understand that energy involves motion. It is not energy unless it is used to do something.

3) Have students describe what they did yesterday or today which used their body power.

4) Have students describe what they would not be able to do if they had no energy.

5) Use pictures from magazines, newspapers etc. and have students describe the body power they see.

6) Make a cooperatively developed bulletin board entitled "Body Power", having students draw pictures and make word cards describing different ways people use their body power.

Math Adaption:

1) Use pictures from magazines and help students to learn concepts of more or less body power. Does it take more body power to brush your teeth or ride your bike?

2) Have students count and compare the number of students needed to move different sizes of tables/desks in the cafertia or room.

Energy: A Teachers Introduction to Energy and Conservation Ottio Department of Education Columbus OH 1975.

An Energy Curriculum for the Elementary Grades Energy Education Curriculum Project Indian Department of Public Instruction 1979.

CONCEPT:

Students will be able to understand energy as it relates to physical activity

SUBJECT:

P.E.
Science
Math

MATERIALS:

Picture sources such as magazines and newspaper

WHO'S USING ENERGY

2

ACTIVITY:

1) Have each student look at the picture.

2) List on the board all the different types of "body power" the students find.

3) Have the students list which person in the picture is using the least "body power". Which is using the most? Make a chart putting the people who are doing the most (using the most energy) on one side of the paper and the people who are using the least amount of energy on the other side.

4) What can you find that show ways people are storing energy in the picture? (ex; sleeping) What can you find in the picture that show people taking in energy?

5) What emotions can you see in this picture? What type of energy do you think they are using/feeling?

6) Find one character in the picture and imagine what they are thinking. Do you think they are using energy? What kind?

CONCEPT:

The students will be able to identify different types of human energy in the following picture.

SUBJECT:

Language Arts

MATERIALS:

Xeroxed copy of picture for each student.

Taken from: Energy Curriculum for the Elementary Grades, Indiana Dept. of Public Instruction, 1979.

USING YOUR HEAD

3

ACTIVITY:

1) Talk with the students about how important thinking is for doing everything. Using pictures from magazines or taking everyday school routines, have the students state or identify what people are thinking and how that is affecting human energy.
EXAMPLE: Math Class-people are thinking about numbers and the answer to the questions.
Play period- people are thinking about how to hit a ball and/or the rules of the game they are playing.

2) Ask the students to think about one problem they solve in class everyday. Have them talk about how they think in order to solve this problem. Discuss how they often feel tired when they have thought hard about a problem.

3) Ask the students to think about a particular idea. Tell them not to tell anyone about it, but to draw pictures of whay they are thinking about. They should not show their pictures to anyone. Let the student do a pantomine about his/her picture. Let the others quess what the student is thinking by his/her pantomine. After quessing, have student share the picture. The student should talk about what thoughts are shown in the picture and how thinking affects and is affected by human energy.

Language Arts Adaptation

1) Put a word on the board. Have the students think about how they would spell and pronounce that word. Have them see how they use their thinking skills in any kind of school activity.

2) Have the students think about a problem and write three sentences which outline their solution to the problem.

Math Adaptation

1) In order to show students how thinking affects their human energy, have students count the number of steps it takes to go from reading groups to the washroom. Then have them discuss how they could reduce the number of steps. Talk with them about how their thoughts have made energy use more efficient.

CONCEPT:

Students will be able to relate the affect of thoughts and ideas on human energy levels and vice versa

SUBJECT:

Language Arts
Math

MATERIALS:

EMOTIONS

4

ACTIVITY:

1) Ask the students to tell you what happens to them that makes them feel good. Discuss with them the affect of feelings on human energy. (When they feel good they generally feel an increase in their energy level.)

2) Discuss with the use of pictures the following emotions:
   a) Happy - lots of energy, can do more things, and help others more;
   b) Sad - want to be alone, often feel weak, energy level low;
   c) Love - makes us feel good, increases our energy level;
   d) Anger - affects our energy use by making us want to fight or hit out;
   e) Care - try to help others, become involved in activities.

3) Have students make a collage or draw pictures using all the feelings discussed.

4) Have students role play different emotions. Stress the importance of using and showing all the emotions.

5) Have the students list the things that have made them the happiest in the past week and the things that have made them the mose unhappy. Classify the most important to least important.

6) Ask the students to take an action that they think will help someone else feel happy or cared for from the time class ends to the beginning of the class the next day. Have students report on the ways they tried to do something.

Math Adaptation

1) Have the students cut out a series of hearts and a series of tears. Have them put the hearts on the things which represent happiness or love or caring. Have them put tears on the things that represent sadness or anger or not caring. Magazine pictures are good for this.

2) Have students use a thermometer to talk about what emotions are stronger that others. Measure the strengths of their emotions.

CONCEPT:

Students will become aware of the effects of emotions on their energy levels.

SUBJECT:

Language Arts
Math

MATERIALS:

Pictures of emotions from magazines
Construction Paper

PEOPLE POWER

5

ACTIVITY:

1) Have each student in the class look at the pictures in the first column. Have them decide which pictures show people thinking. Have the srudents explain their answers. Continue with the next columns.

2) Have the students color the squares that they think show each of the following categories: human energy use as physical energy or emotional energy.

3) Give each student manilla paper. Fold the paper into fourths. Have the students draw a picture of each category and write a sentence about each picture. On the last square let the students pick a category and do the same but do not tell anyone which category they picked. Through pantomime, let the class guess which category was chosen by each student. Have the student explain their picture.

CONCEPT:

Through the use of pictures, students will be able to identify people using physical and emotional energy.

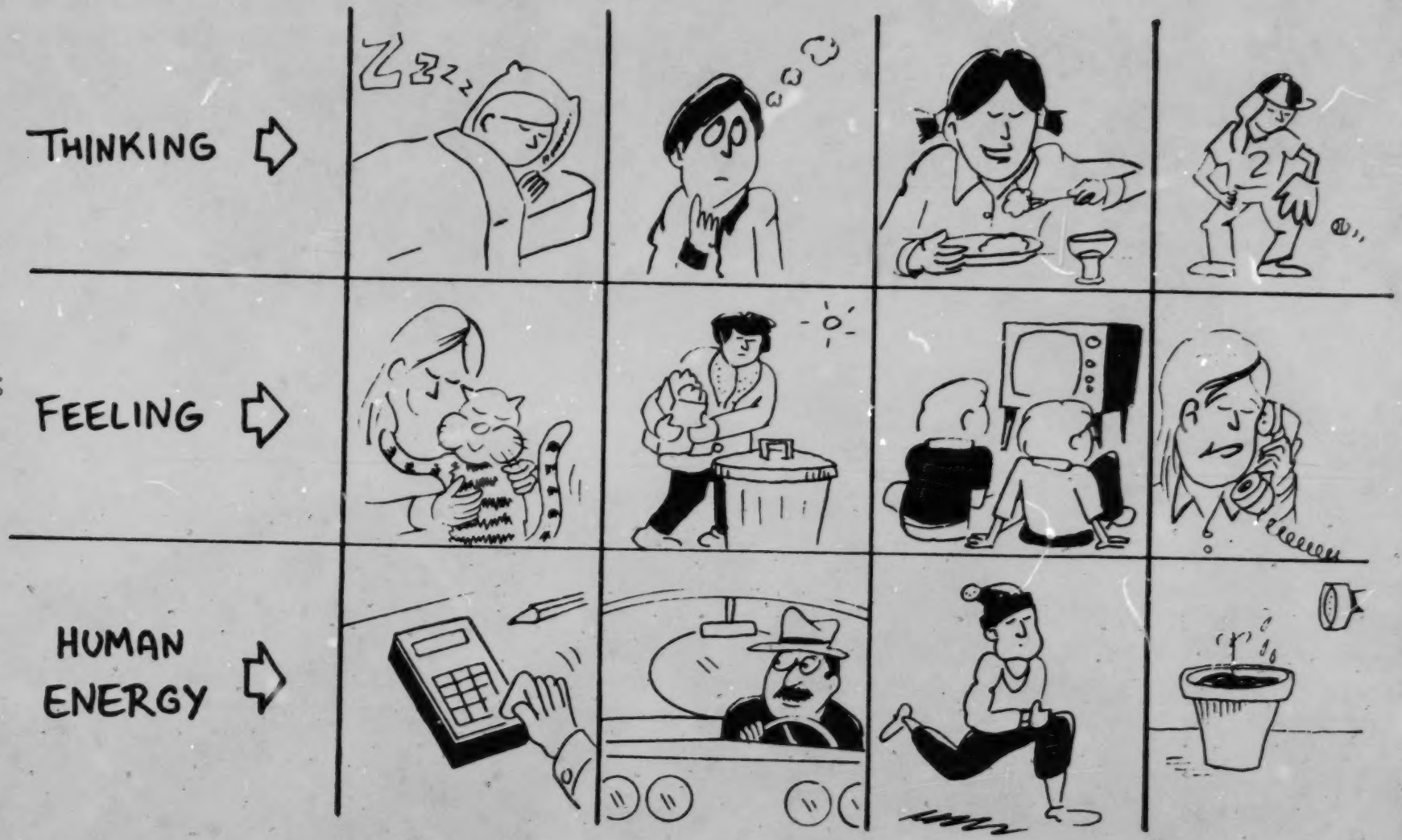
SUBJECT:

Art
Language Arts

MATERIALS:

Xeroxed copy of the activity sheet per student
Manilla paper
Crayons or colored pens

Taken from: An Energy Curriculum for the Elementary Grades, Indiana Dept. of Public Instruction, 1979.



ENERGY FROM FOOD

6

ACTIVITY:

Background: Food energy is found in nutrients (proteins, carbohydrates, fats, etc.). Energy is released into the blood-stream during the process of digestion. Sugar is released faster than the other food elements, but it is not the most nutritional. Food energy is measured in calories.

1) Pass out several bowls with different types of grain in them to the students. (oats, corn etc.) After a few minutes ask the students to describe them. (size, color, texture, palatability, etc.). Help them to identify the grains and ask them if they ever eat them and in what form. Place breakfast cereal boxes on the table and have the students match each cereal with the grain it is made from.

2) Ask the students why they eat cereals (for energy). Then have the students describe the process food goes through in the body to become energy, pointing to each area. (Teeth chew the food, tongue and throat swallow it, stomach processes it, etc.)

3) Have each child find their heart and feel it's beat. When they feel it they should stand up. When all the children are standing, have them do ten jumping jacks. Then they should feel their heart beat again. Is it beating slower or faster then before the jumping jacks? What happens to the food energy? When all the food energy is used up what happens? (feel hungry)

4) Pass out newsprint folded in half, crayons, and pencils. On the left side have the students draw a picture of their favorite food. On the right side, have them draw a picture of something they can do with the energy of that food. Have them write a sentence about their picture.

5) Use the pictures to make a bulletin board for the class.

CONCEPT:

Students will develop an understanding of food as a source of energy.

SUBJECT:

Science
Arts
Language Arts

MATERIALS:

Pencils, Crayons
Paper
Seed samples of cereals
Bowls
Processed cereals

AN APPLE A DAY

7

ACTIVITY:

1) Give each student an apple.

2) Discuss the concept of factories with the students. Explain to the students how an apple is made in relationship to the tree. (The apple grows on a tree which gets it's energy from the leaves which collect the sunlight and mix it with the water from the roots.

3) Have the students eat their apples and discuss the taste and texture of the apple. Have them save their seeds to plant afterwards.

4) As the students finish their apples give them a pot and some dirt and have them plant them.

5) Introduce the children to the story of Johnny Appleseed either through film or book. Discuss the food value of apples. What happens after you eat an apple? (Do you feel full?)

6) Have the students draw a food chain or cycle which shows the path the apple they have eaten has gone through from seed to seed.

CONCEPT:

Students will be able to draw a food cycle.

SUBJECT:

Science

MATERIALS:

Apples
Pots, Potting Soil
Book or Film of Johnny Appleseed

ORIGINS

8

ACTIVITY:

The food we eat supplies our bodies with the energy we need to live. Some foods take more energy to produce than others. Vegetables and fruits require energy in the form of planting, fertilizing, irrigating, machinery, harvesting and transporting. Because meats are higher on the food chain, they require more energy to produce than plants. The more processes a food undergoes the higher the energy costs.

1) On a large poster or bulletin board have students match the pictures of foods in column A below with the pictures or names of the animals and plants listed in column B. Refer to cookbooks, package labels etc. for a listing of the ingredients in the different foods.

2) Expand the activity to include classification exercises such as all foods made from tomatoes etc..

3) Discuss with the students the interdependent relationship we have with plants and animals and the necessity of preserving the soil that allows them to grow.

Column A	Column B
ketchup	cow
hamburger	pig
french fries	chickens
raisins	apple tree
peanut butter	sugar cane
grape jelly	sugar beets
spaghetti	dried bean plant
rice crispies	cucumbers
corn flakes	corn plant
crackers	soy bean
cheese	cocoa tree
popcorn	popcorn plant
candy bar	potato plant
applesauce	grape vines
bologna	peanut plants
jello	rice plants
chili	oat plant
pickles	wheat plant
ice cream	yeast cells
butter	
coca cola	
root beer	

CONCEPT:

Students will understand that the food we eat comes from plants and animals.

SUBJECT:

Science
Social Studies

MATERIALS:

Pictures of food, plants, animals.

MINES AND MAYONNAISE

9

ACTIVITY:

1) Make mayonnaise using the following recipe:

Ingredients:

1 tsp. salt	2 egg yolks
½ tsp. dry mustard	2 Tblsp. vinegar
¼ tsp. paprika	2 cups salad oil
dash of cayenne	2 Tblsp. lemon juice

Directions: In a small bowl, mix dry ingredients; blend in egg yolks. Add vinegar and mix well. Add salad oil, 1 teaspoon at a time, beating at medium speed with an electric mixer (this can also be done by hand) until ¼ cup of oil has been added. Add remaining oil in increasing amounts, alternating the last ½ cup with lemon juice. Makes 2 1/3 cups of mayonnaise.

2) Cut out the picture shapes below. Discuss where each belongs on the larger picture. Students can paste and color these pictures.

3) Ask the students to tell the class where each of the ingredients originated and draw a picture of the steps each went through back to it's source in the earth. For example, salt from a salt mine, etc..

Math Adaptation:

Discuss with the students why a recipe is necessary. Then have the students measure out each of the ingredients.

CONCEPT:

The ingredients of a food product come from many sources in the natural environment.

SUBJECT:

Art
Math

MATERIALS:

Crayons
Scissors
Mixing bowl
Measuring spoons
Measuring cup
Electric mixer or whisk
Ingredients for mayonnaise
Xeroxed copy of mayonnaise picture per student

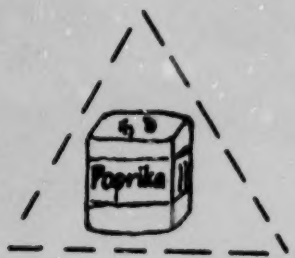
Taken from: Energy, Food, and You, Washington State Office of Public Instruction, 1978.

Salt

Egg

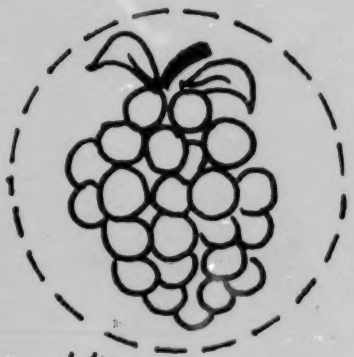
Lemon

Cayenne



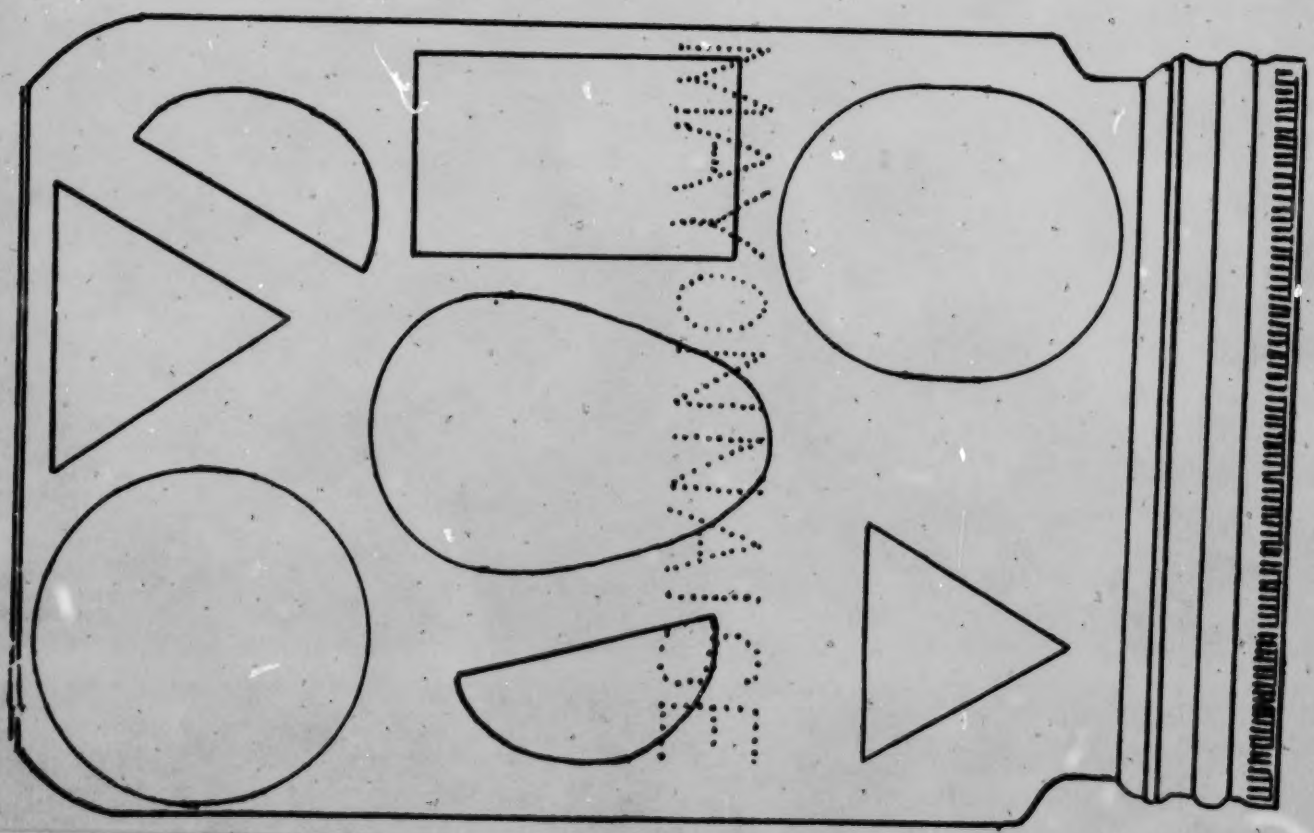
Paprika

Mustard



Vinegar

Oil



WHERE MY BODY GETS ENERGY

10

ACTIVITY:

1) Pass out a copy of the following story to each member of the class.

2) Have various readers read parts of the story, then discuss the concepts presented.

3) Have the students trace the energy source from the sun to the person.

4) Color the pictures.

CONCEPT:

The sun provides energy for all life. Energy is captured by plants and transferred to animals through food chains.

SUBJECT:

Science
Language Arts

MATERIALS:

Xeroxed copy of the story for each student

Taken from: Energy, Food and You, Washington State Offices of Public Instruction, 1979.

Where Does My Body Get Its Energy?

The sun shines on the farm.

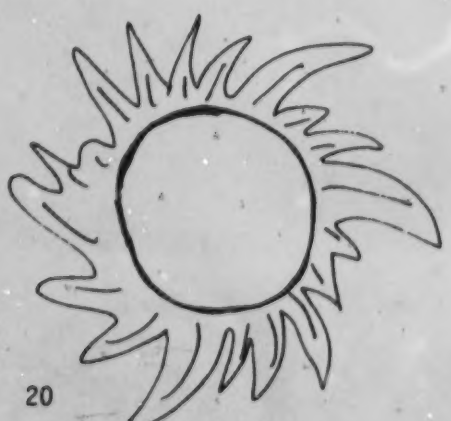
The plants in the field take the sunshine and store it in their cells.

My body takes the energy when I eat the plant.

A cow gets energy by eating the plants called grass.

Your body takes the energy when you drink milk from the cow.

Almost all energy comes from the sun.



FOOD WEBS

11

ACTIVITY:

1) Using pupils to represent the components of a food web you will construct models of two or three food chains and convert them into a food web.

2) Break the class into two groups: one will be the audience the other half will be the food web.

3) Prepare six 12 inch cards lettered with such labels as sun, soil, green plants, mouse, grasshopper, earthworm, snail, frog, shrew, robin, garter snake, rabbit owl fox, etc. Make enough cards to supply about half the class.

4) Take a ball of string and cut it into lengths long enough to connect the links in the food web.

5) Assign a card to each pupil. Starting with the sun, connect it to green plants by asking the two pupils to hold a length of cord between them. Now connect one of the plant eaters to a plant; follow this with a meat eater linked to a plant eater etc.

6) Now that you have created a food web all interconnected with string ask the students the following questions:
-Why is the sun necessary for all life?
-What is the source of food used by animals?
-In a natural environment, what would happen if you removed an entire species from the food web? (Remove all the children of one species)
Discuss the interdependence of species.

CONCEPT:

All living things fit into a food web and are dependent upon each other.

SUBJECT:

Ball of string or yarn 12 inch cards.

MATERIALS:

Science

STEWED SUNSHINE

12

ACTIVITY:

1) This activity is centered on a puppet show called "Stewed Sunshine". Have each child make a puppet using scraps of material on pieces of wood or by cutting out figures from construction paper and glueing felt scraps onto them. Make "puppets" for the non-speaking parts as well.

2) Pass out the following script to each student or have the script recorded on tape and played to the class. As the story is read the puppeteers would manipulate their puppets to the story.

   Background music could also be added.

Taken From: Interdisciplinary Concepts and Activities, Lee County Schools, Florida.

CONCEPT:

The sun's energy is captured by plants and transferred to animals through food chains.

SUBJECT:

Science
Language Arts
Arts

MATERIALS:

A Script for each student
Puppets or material to make them

Stewed Sunshine

Child - "Mom, I'm tired and I'm hungry."

Mother - "Maybe you are tired <u>because</u> you're hungry."

Child - "No, I'm tired because I played soccer."

Mother - "How are we going to pep you up again? Where does your body get its energy?"

Child - "I think it comes from what I eat."

Mother - "You're right! Did you ever wonder where

the food gets that energy? Do I add it in the kitchen along with the baking powder?"

Child- "I don't think you add it, but I'm not sure where it comes from. Maybe it just grows into it."

Mother- "That energy comes from the sun. Plants store it as they grow. When we eat plants we get that energy. Animals get it from the plants they eat,

and we in turn get it from the animals or plants when we eat them."

Child - "I'm getting hungrier just talking about food.

Mother - "Then let's give you something that will fill you with energy <u>and</u> give you other things that help your body. Some food will fill you up but does not give you any of those other things."

Child - "That's the junk

food you are always talking about."

Mother- "You are learning. If you eat right your body will perform better, and you'll have more pep."

Child - "Canned, fried or stewed - sunshine, I'm ready for you."

Mother- "Try this cheese and sprout sandwich."

Child - "I'll add a layer of peanut butter."

Mother Trucks also use energy to deliver

food to our part of the country."

Child - "Do they run on sunshine too?"

Mother - "In a way. Gasoline is energy from plants that grew millions of years ago."

Child - "Big trucks deliver food to the supermarket."

Mother - "Right. But no truck is needed to deliver the food growing in our garden."

Child- "Mom, I'm still hungry."

Mother- "Have some juicy sunshine from the backyard, called an apple."

Can you fill in the steps – 1 to 3? Complete the drawings.

FERTILIZER FROM MY FOOD

13

ACTIVITY:

Explain to the students that composting can turn food wastes into fertile soil. Make a list of those wastes that can be composted and draw a diagram like the one below to show layering in a bin.

1) Set up a composting bin outside your classroom. You can build a box or other container and use a tight fitting lid.

2) Begin collecting food scraps from lunch and encourage the students to bring things from home such as grass clippings, wood ashes, leaves etc.

3) Put the scraps in the container each day and cover with a little dirt to discourage flies.

4) Introduce earthworms into your compost.

5) Moisten your compost occassionally and stir it to provide air for the organisms that decompose the scraps.

6) Observe the compost for activity. Decomposition takes from 1-3 months.

7) Use the compost on a garden project.

8) Discuss with the students the following topics:
-Man can follow nature's way of turning waste products back into soil.
-Homemade fertilizers use less energy than store bought ones. Compare the steps it takes to produce store-bought fertilizer with homemade fertilizer.

CONCEPT:
Human and animal recycling or organic wastes completes natural nutrient cycles and improves soil structure and fertility.

SUBJECT:

Science

MATERIALS:

Large wooden box or other container
Food and Yard scraps
Shovel or soil turning implement.

ENERGY MOBILES

14

ACTIVITY:

1) Have each student bring a wire coat hanger from home. Using wire snappers cut the hangers into three 6-8 inch pieces.

2) Pass out some oaktag or construction paper to each student with some super strength thread.

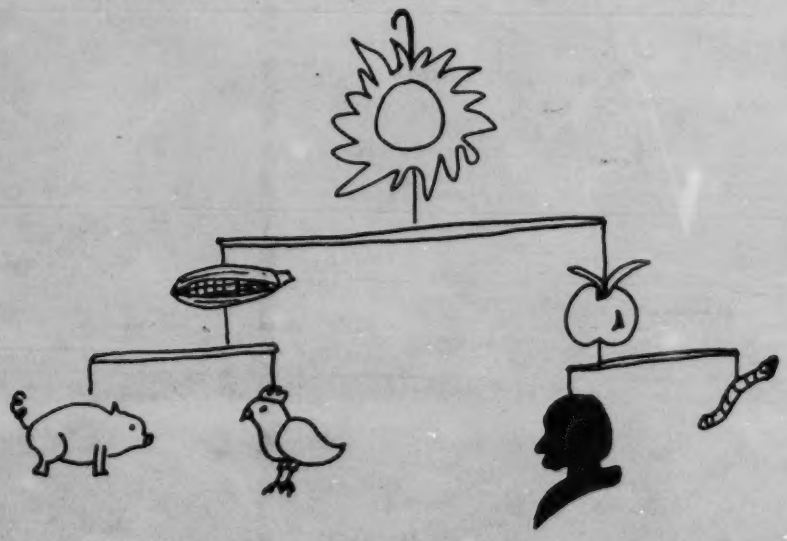
3) Have the students cut out mobile objects which represent the sun, two plants, and four animals as is suggested in the pictures below. If you use construction paper for the figures, it is recommended that it is cut double and glued together to give it more weight.

4) The highest point will be the sun and hanging from that will be a wire with a different plant hanging at each end. From each plant should hang an eater wire.

5) Use the thread to connect the pictures to the wire hangers and a paper clip can be placed at the top as a hanger hook. Be sure to warn the children to balance their mobil objects carefully so they will hang properly.

6) Place the mobiles around the room. Discuss with the students what would happen if a plant were removed. (The animals below it would fall off.)

7) Have the class make a large mobile showing more complex food webs.



CONCEPT:

The interdependence of plants and animals as shown in a food web.

SUBJECT:

Art
Science

MATERIALS:

Wire Snappers
Coat Hangers
High gauge thread
Construction paper or oaktag
Scissors for students
Crayons/colors

ENERGY TRACE

15

ACTIVITY:

1) Discuss the different sources of energy. Ask the students to list energy forms.

2) Using the energy flow chart below, organize the energy flow and reproduce it on the blackboard.

3) Ask the students to make observations about which categories are the furtherest away from the sun. For example, how many steps does electricity have?

4) Have the students fill out the "Energy Trace" worksheet.

5) Without reference to the display, hold a "Source-Down" like a spell down. Choose two teams of equal size. The first person on Team A is shown an energy user (e.g. an oil furnace), He/she must name the type of energy used (oil). If he/she misses, then the question goes to the first person on the other team. The next person must tell where the oil comes from (plants) and so on, until each source is eventually traced back to the sun.

CONCEPT:

Energy flow in natural systems.

SUBJECT:

Science
Social Studies

MATERIALS:

Copies of the following sheets for each student:

Energy Trace,
Sources of Energy,
Energy:Steps to a Warm Home

Taken from: Energy, Food, and You, Washington State Office of Public Instruction, 1978.

ENERGY TRACE

Almost all energy we use on earth can be traced back to the sun's energy. Use the bulletin board display to trace the forms of energy listed on this page back to the sun. The first one is done for you. For "furnace" you may choose any type of furnace (coal, oil, etc.) See diagram page 8.

COAL → PLANTS → SUN

WINDMILL → _____ → SUN

PLANTS → _____

PETROLEUM → _____ → _____

↳ _____ → _____

WIND → _____

SAILBOAT → _____ → _____

CLOCK → _____ → _____ → _____

AIRPLANE → _____ → _____ → _____

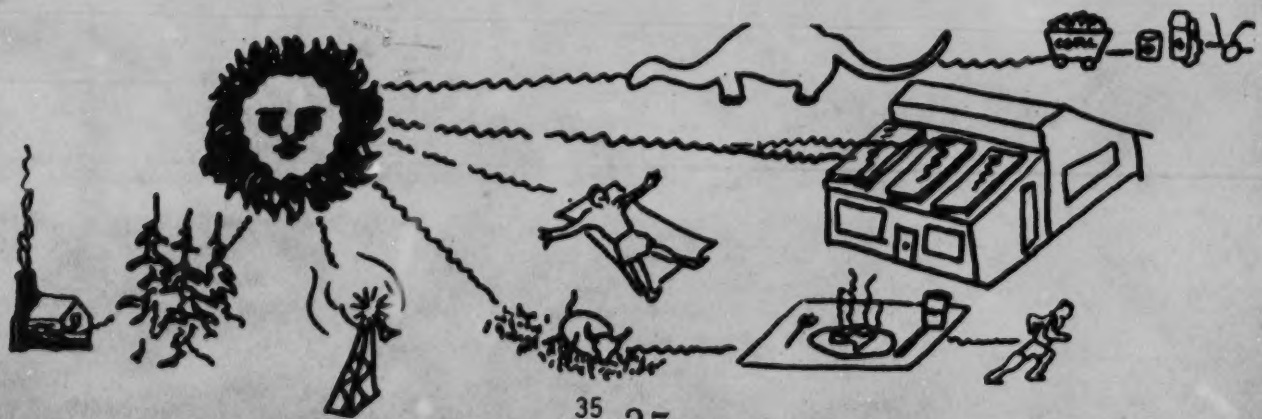
AUTOMOBILE → _____ → _____ → _____

TRAIN → COAL → _____ → _____

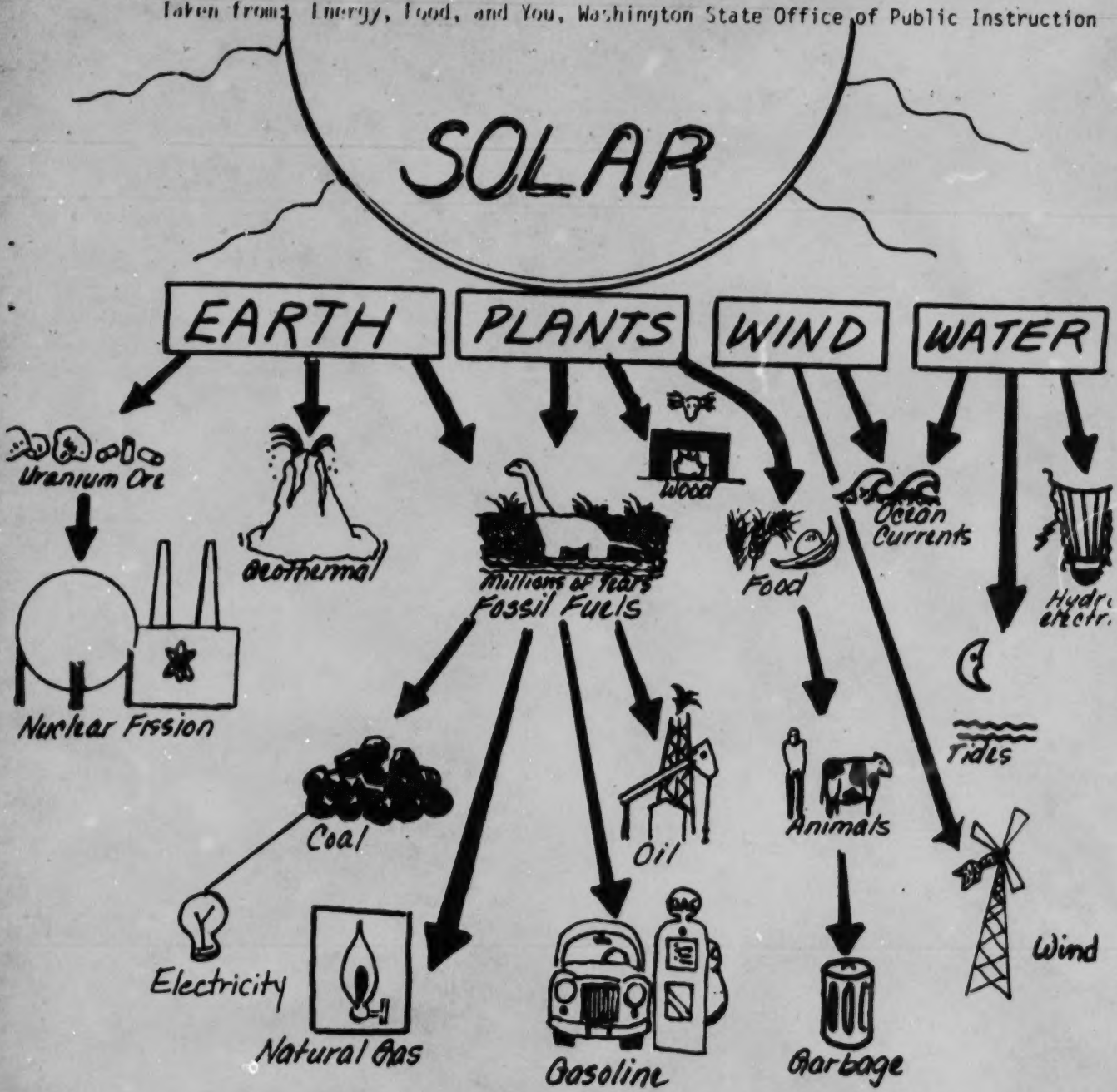
FURNACE → _____ → _____ → _____

WOOD → _____ → _____

TREE → _____



Taken from: Energy, Food, and You, Washington State Office of Public Instruction

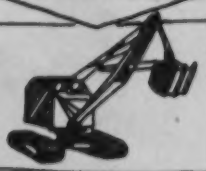
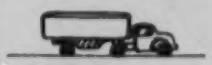
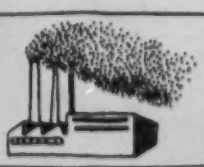
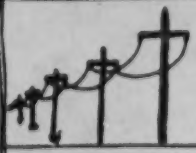
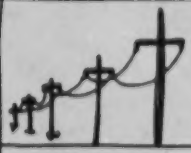
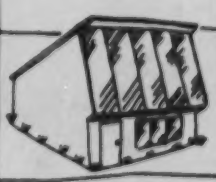
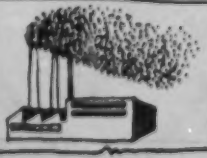


Sources of Energy from the Sun

What sources & uses can you add?

Taken from: Connections, National Center for Appropriate Technology, 1980.

ENERGY
STEPS TO A WARM HOME

	NUCLEAR	COAL	HYDRO	SOLAR
MINING				
LAND RECLAMATION				
TRANS-PORTATION				
ENRICHING				
TRANS-PORTATION				
GENERATING				
TRANSMISSION				
WARM HOME				
WASTE & POLLUTION				

DO YOU KNOW YOUR ENERGY SOURCES?

16

ACTIVITY:

1) Review energy sources with the class, discussing such things as electricity, coal, oil, natural gas, wind, sun, food, and wood.

2) Have the students color the accompanying picture. Discuss with them the concept of energy flow.

3) The following chart has a list of some common objects that need energy to make them work. Place an "X" in each column whose energy source will directly power the object. The first line is already answered.

Take From: Energy Activities: A Station Approach, Land Between the Lakes, Tennessee Valley Authority.

CONCEPT:

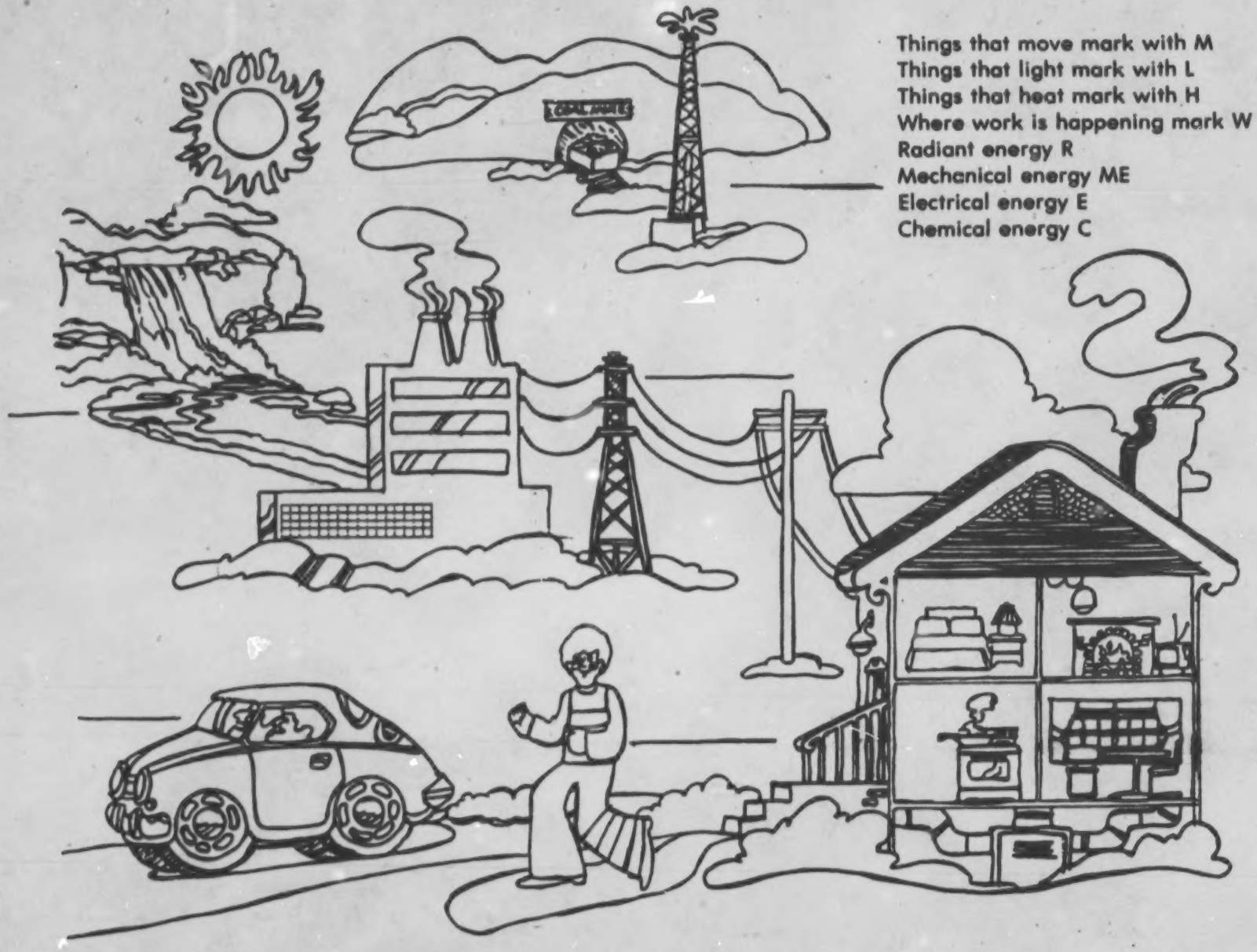
Energy flow in natural systems.

SUBJECT:

Science

MATERIALS:

Pencils
Xerox of worksheet and picture per student
Crayons


Things that move mark with M
Things that light mark with L
Things that heat mark with H
Where work is happening mark W
Radiant energy R
Mechanical energy ME
Electrical energy E
Chemical energy C

Do You Know Your Energy Sources?

This is a list of some common objects that need energy to make them work. Place an "X" in each column whose energy source will directly power the object. The first line is answered for you.

	1. Electricity	2. Coal	3. Oil	4. Natural Gas	5. Battery	6. Sun	7. Food	8. Wood
Clock	X				X	X	X	
Automobile								
Toothbrush								
Radio								
Bicycle								
Corn Popper								
Typewriter								
Stereo								
Piano								
Toaster								
Television								
Scissors								
Water Heater								
Flashlight								
Fan								
Airplane								
Calculator								
Lawn Mower								
Lamp								
Flower								
Vacuum Cleaner								
Furnace								

NAME _____

Modified by permission of the Southern California Edison Company.

ENERGY FLOW IN NATURAL SYSTEMS

17

ACTIVITY:

1) Have students list various energy sources and their relation to the sun. Examples might include:

Fossil fuels	Fossil fuels are formed from decayed plants and animals. Plants get their food through photosynthesis (see chart).
Geothermal	Geothermal energy is the earth's heat.
Water power	We need rain in order to have a water supply. Without the sun there would be no water cycle.
Nuclear	The cyclotron or "atomic gun" is used to speed up and release the nuclei of hydrogen atoms or the nuclei of helium atoms and split other atoms(fission). The cyclotron needs electrical charges in order to operate. This traces the sun as the original source of energy.

2) Solar energy is being used to do work for us. Some examples include:
   a. Solar heating systems for houses and buildings.
   b. Solar cookers.

3) Role play being a solar engineer who has the job of inventing new things that use solar energy.

CONCEPT:
All forms of energy originated with the sun.

SUBJECT:
Science

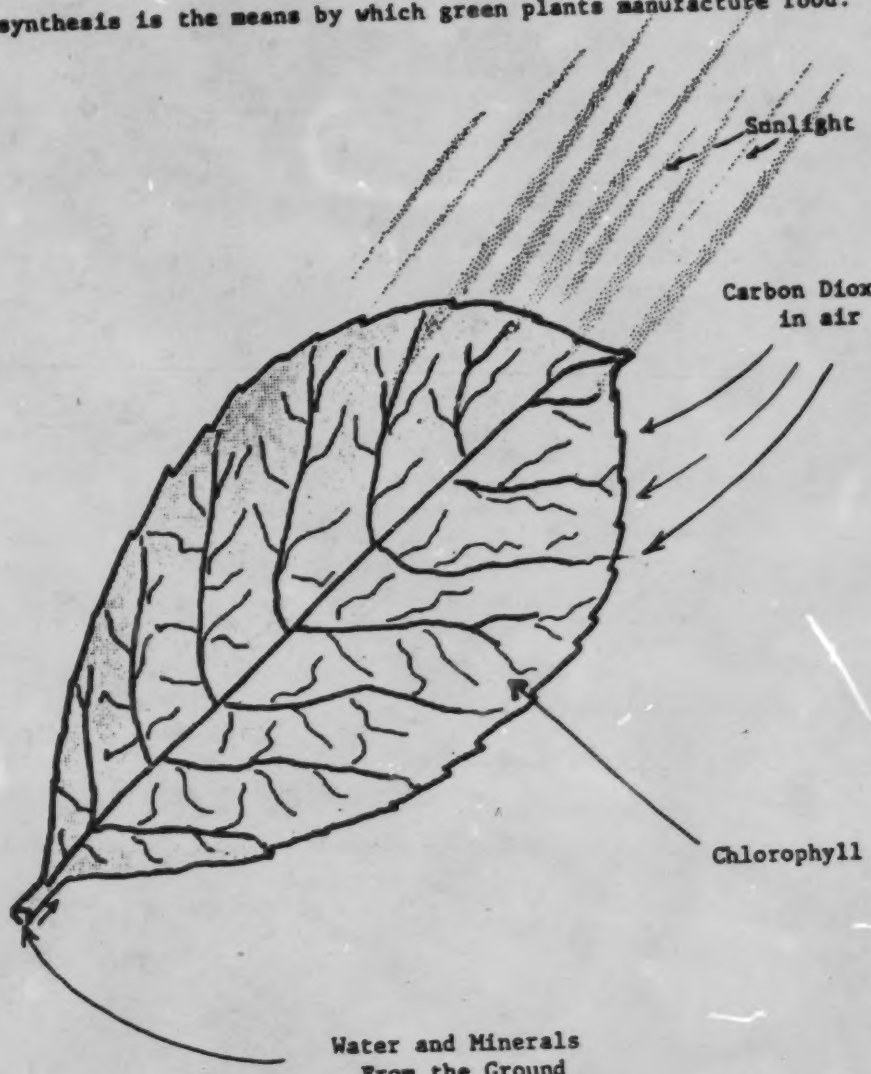
MATERIALS:
Photosynthesis chart

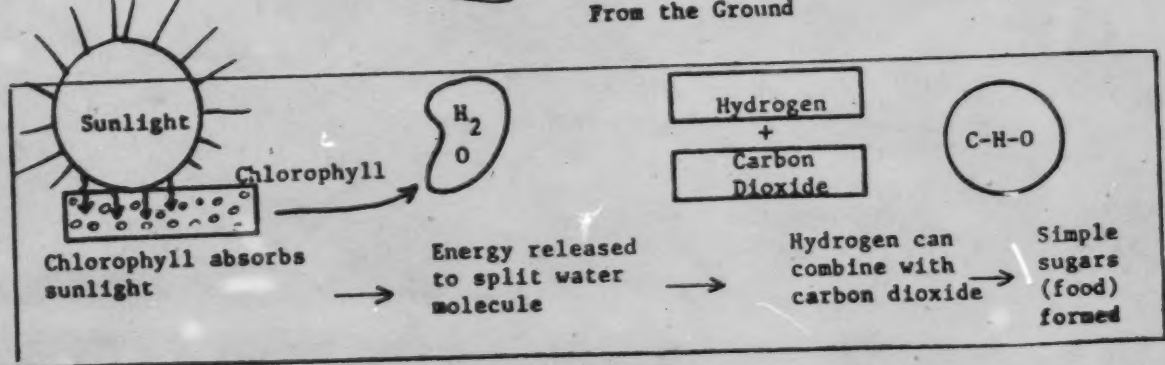
Transparency

Sunlight - yellow
Chlorophyll - green
Leaf - green

PHOTOSYNTHESIS

Photosynthesis is the means by which green plants manufacture food.





ENERGY SOURCES IN KENTUCKY

18

ACTIVITY:

Discuss with your students different energy sources such as coal, oil, nuclear, solar, etc.

Give each student a map of Kentucky and have them locate on it the following energy sources: coal mining & processing, hydroelectric, synfuel, and feasible areas for wind and solar. Included in the following pages are reference maps which identify some of these areas. (Have the students use different colored pens for each energy source.)

CONCEPT:

The student will become aware of the different energy sources available in Kentucky.

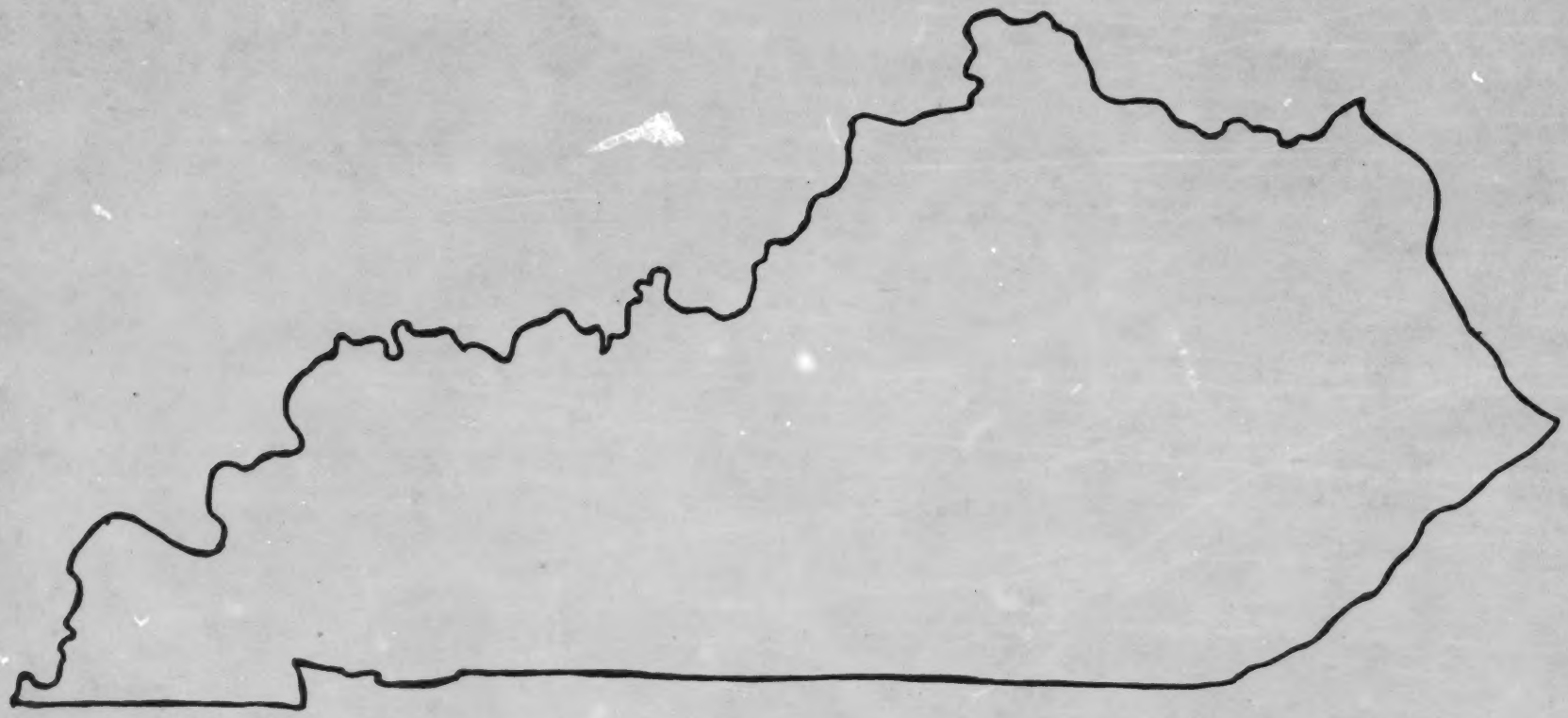
SUBJECT:

Science
Social Studies

MATERIALS:

Map of Kentucky for each student
Colored pens or crayons
Reference maps

MAP OF KENTUCKY



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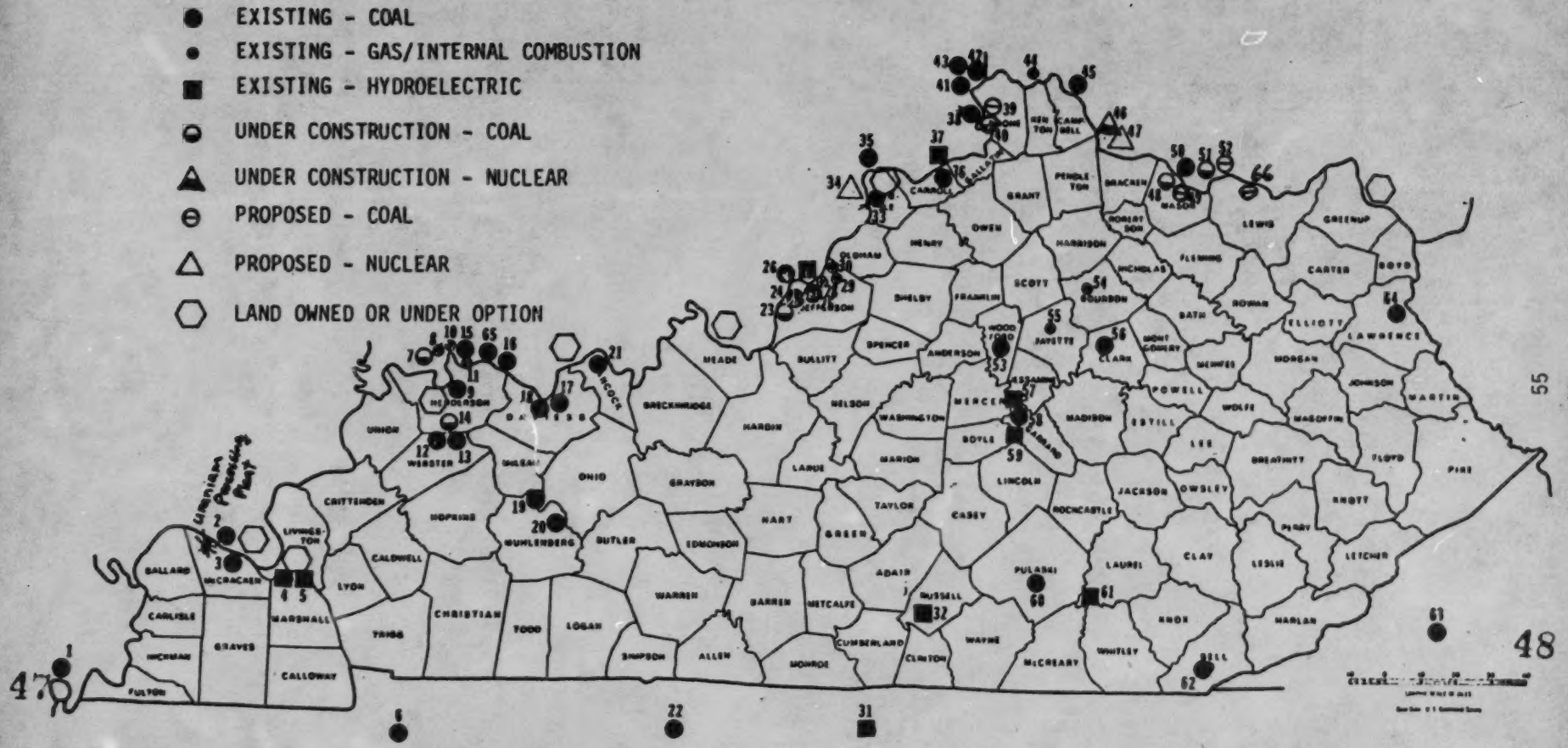
45

46

ELECTRIC POWER PLANTS



Prepared by
Division of Air Pollution Control
Bureau of Environmental Protection
Kentucky Department for Natural Resources &
Environmental Protection

EXISTING, UNDER CONSTRUCTION AND PROPOSED
ELECTRIC POWER PLANTS

1.	NEW MADRID	-	500MW
2.	JOPPA	-	1050MW
3.	SHAWNEE	-	1750MW
4.	KENTUCKY DAM	-	175MW
5.	BARKLEY DAM	-	130MW
6.	CUMBERLAND	-	2548MW
7.	A.B. BROWN	-	255MW
8.	OHIO RIVER	-	179MW
9.	HENDERSON #1	-	48MW
10.	NORTHEAST	-	24MW
11.	BROADWAY	-	53MW
12.	HENDERSON #2	-	350MW
13.	REID #1	-	126MW
14.	REID #2	-	200MW
15.	ALCOA	-	732MW
16.	CULLY	-	397MW
17.	ELMER SMITH	-	438MW
18.	OWENSBORO #1	-	255MW
19.	GREEN RIVER	-	360MW
20.	PARADISE	-	2558MW
21.	COLEMAN	-	510MW
22.	GALLATIN	-	1060MW
23.	MILL CREEK	-	1580MW
24.	CANE RUN	-	1585MW
25.	PADDY RUN	-	316MW
26.	GALLAGHER	-	637MW
27.	OHIO FALLS	-	80MW
28.	WATERSIDE	-	45MW
29.	ZORN	-	18MW
30.	CANAL	-	58MW
31.	DALE HOLLOW	-	54MW
32.	WOLF CREEK	-	270MW
33.	WISES LANDING	-	2340MW
34.	MARBLE HILL	-	3500MW
35.	CLIFTY CREEK	-	1300MW
36.	GHENT	-	1000MW
37.	MARKLAND DAM	-	51MW
38.	SWITZERLAND	-	650MW
39.	EAST BEND #1	-	600MW
40.	EAST BEND #2	-	600MW
41.	TANNERS CREEK	-	1020MW
42.	MIAMI FORT #1-6	-	705MW
43.	MIAMI FORT #7	-	500MW
44.	WEST END	-	219MW
45.	BECKJORD	-	1300MW
46.	ZIMMER #1	-	792MW
47.	ZIMMER #2	-	1150MW
48.	SPURLOCK #1	-	300MW
49.	SPURLOCK #2	-	485MW
50.	STUART	-	2400MW
51.	KILLEN #1	-	600MW
52.	KILLEN #2	-	600MW
53.	TYRONE	-	138MW
54.	PARIS POWER	-	11MW
55.	HAEFLING	-	66MW
56.	DALE	-	176MW
57.	DIX DAM	-	24MW
58.	BROWN	-	710MW
59.	LOCK #7	-	2.1MW
60.	COOPER	-	300MW
61.	LAUREL RIVER	-	60MW
62.	PINEVILLE	-	35MW
63.	CLINCH RIVER	-	720MW
64.	BIG SANDY	-	1080MW
65.	WARRICK	-	732MW
66.	AEP	-	2600MW

COAL, A RESOURCE IN KENTUCKY

19

ACTIVITY:

"What color is coal? (Black) Does anyone know where we find it?" (Underground) Obtain sample of coal for students to feel and examine.

First Page

Describe what is shown in the picture--mountains, trees, sun, sky, etc.

"This is a picture of a place where coal is found. We could say then that coal is found where? (In the mountains) Can it also be found in other places?" (In the Midwest Plains)

Second Page

"What do we call a person who takes coal from the ground? (Miner) Describe how a miner is dressed-- hard hat with light, work clothes, heavy shoes, face mask, etc. Tell what he does--uses drills and other equipment to dig out the coal. Why does he wear a face mask?" (To prevent breathing coal dust)

Third Page

"Where does a miner work? (Coal mine) How is the coal dug from the inside of the mine?" (A large mining machine with many teeth on a rotating wheel tears the coal from the mine walls)

Fourth Page

"Some coal that is found near the surface of the earth is obtained by strip mining. What kind of equipment is used to mine this coal? (Huge power shovels and bulldozers. Point out the size comparison between the man and the power shovel.) To reach the coal, the earth above (overburden) is dug away and piled high in rows. Would you like to see these piles in your community? What could be done to make the land look better?"

CONCEPT:

Coal is mined in Kentucky and it is a Source of Energy

SUBJECT:

Science and Social Studies

MATERIALS:

Coal and Energy Picture Book #5
Sample of Coal
Coal Energy Stamps

Coal and Energy is taken directly from:

NSTA-Energy Environment Mini-Unit Guide

19

CONCEPT:

SUBJECT:

MATERIALS:

ACTIVITY: (Continued)

Fifth Page

"How is coal moved from place to place? (Truck and railroad car) Why isn't it sent by airplane?" (Too heavy and bulky)

Sixth and Seventh Pages

"Where is most of the coal sent? (To power plants to produce electricity) What happens at the power plant? (Coal is burned to produce heat and the heat is used to make steam. The steam is then used to produce electricity) What is coming out of the smokestacks of the power plant? (Smoke, gases, and heat) Is it good for people to inhale smoke? Why not? (Harms the lungs) What could be done to prevent the smoke from going into the air?" (Put "catchers" in the chimney)

Eighth Page

"What are some of the used made of coal? (Coal products help make paints, plastic for records and dishes, and coal is used to make heat to produce electricity) Name three things in our room that were made partly from coal." (Make display of products made with the aid of coal)

Ninth Page

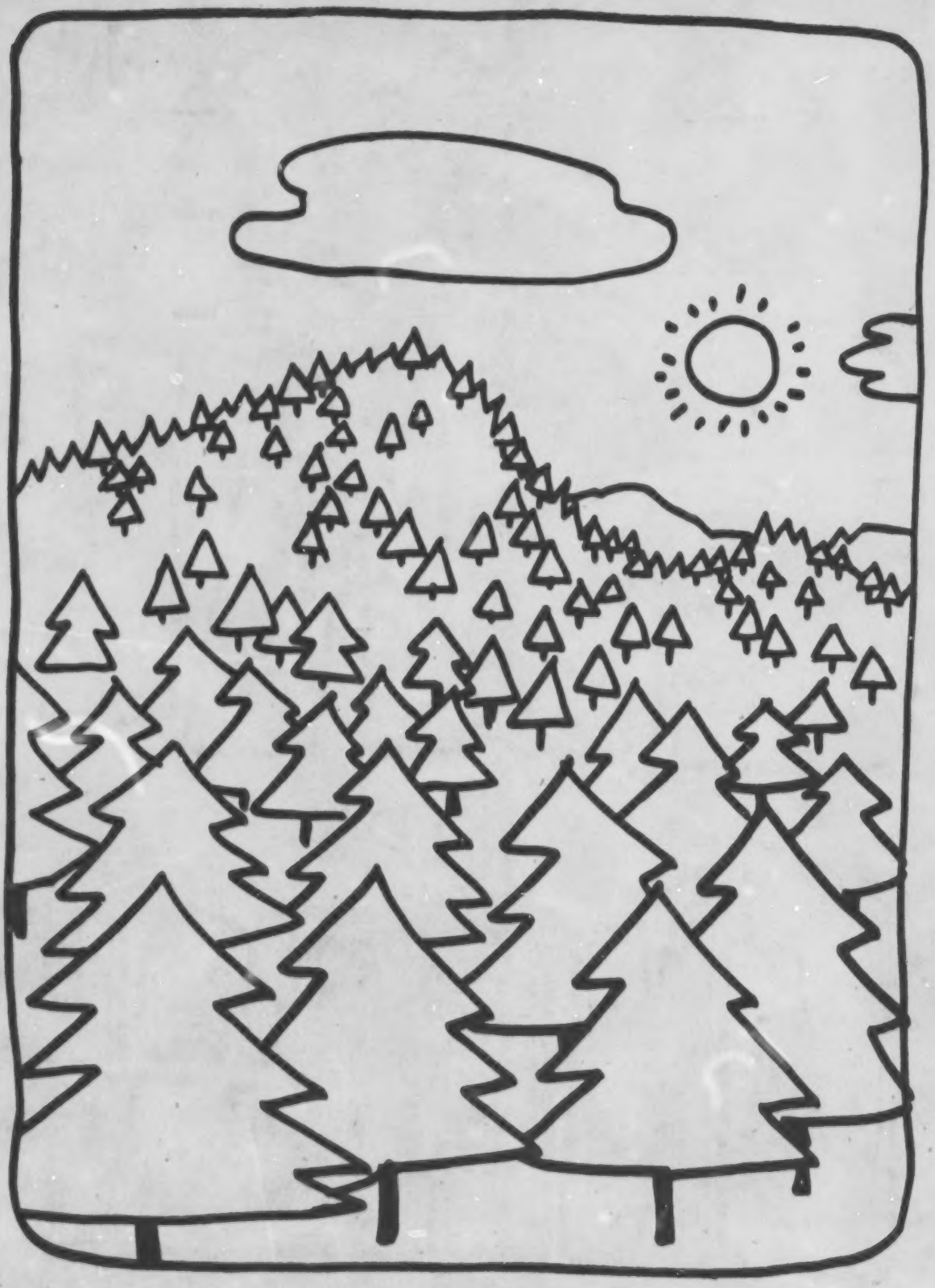
Review vocabulary.

"Place a check by the forms of energy you have studied so far."

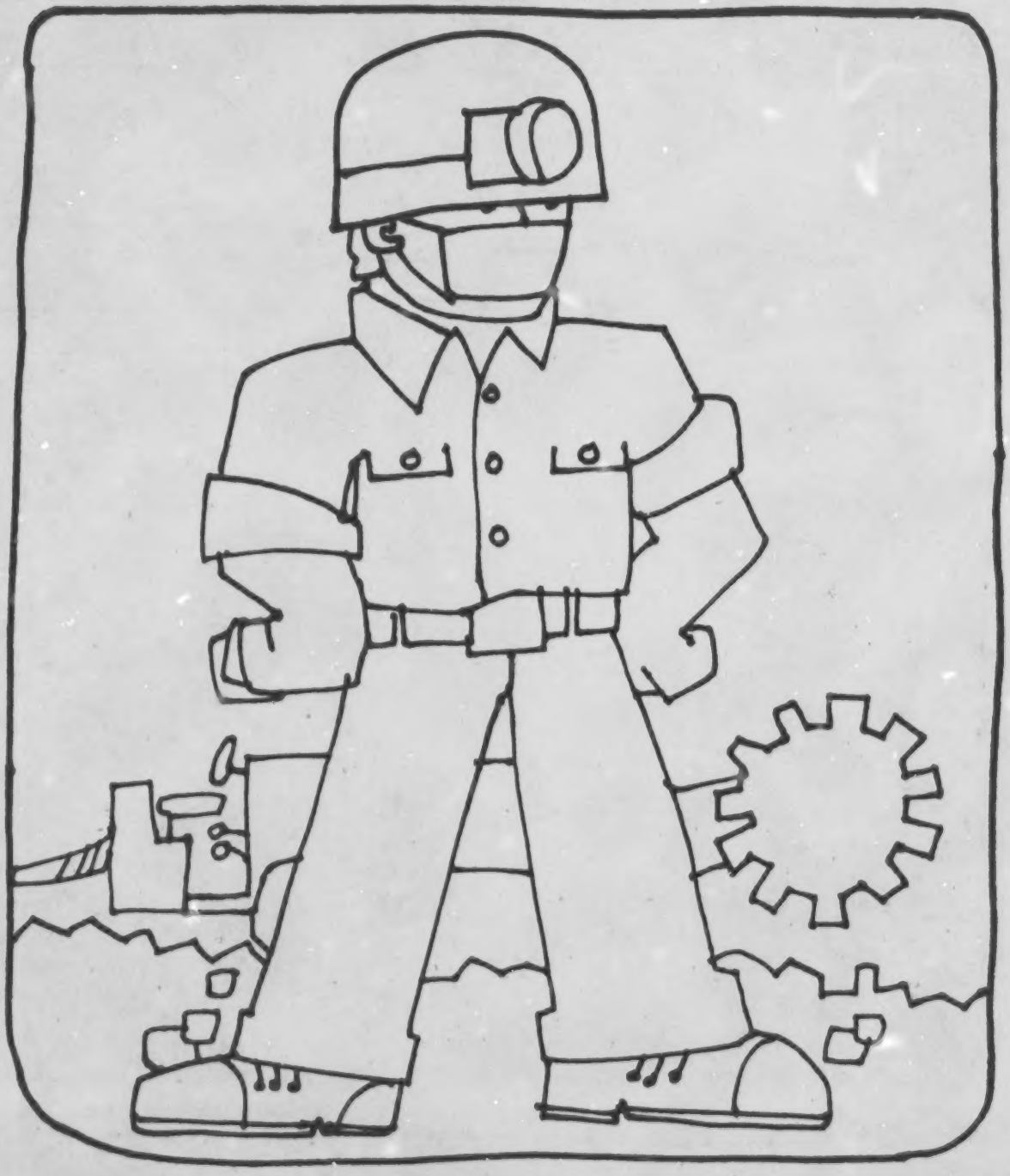
End this lesson by allowing students to color their favorite parts. Next day pass out Coal Energy Stamps and have students complete the picture. Again, students may add captions to pictures.

BOOK FIVE

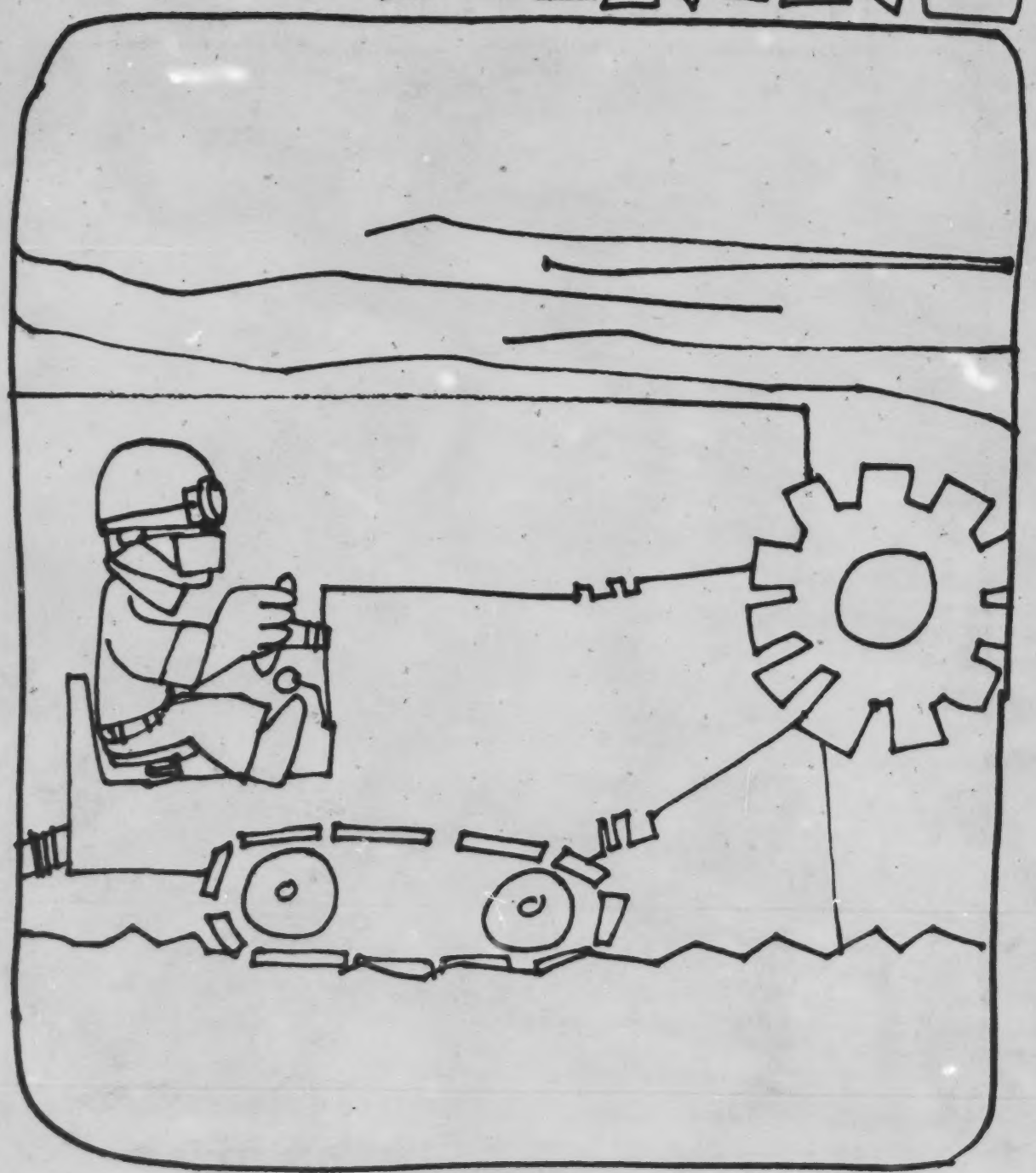
COAL AND ENERGY



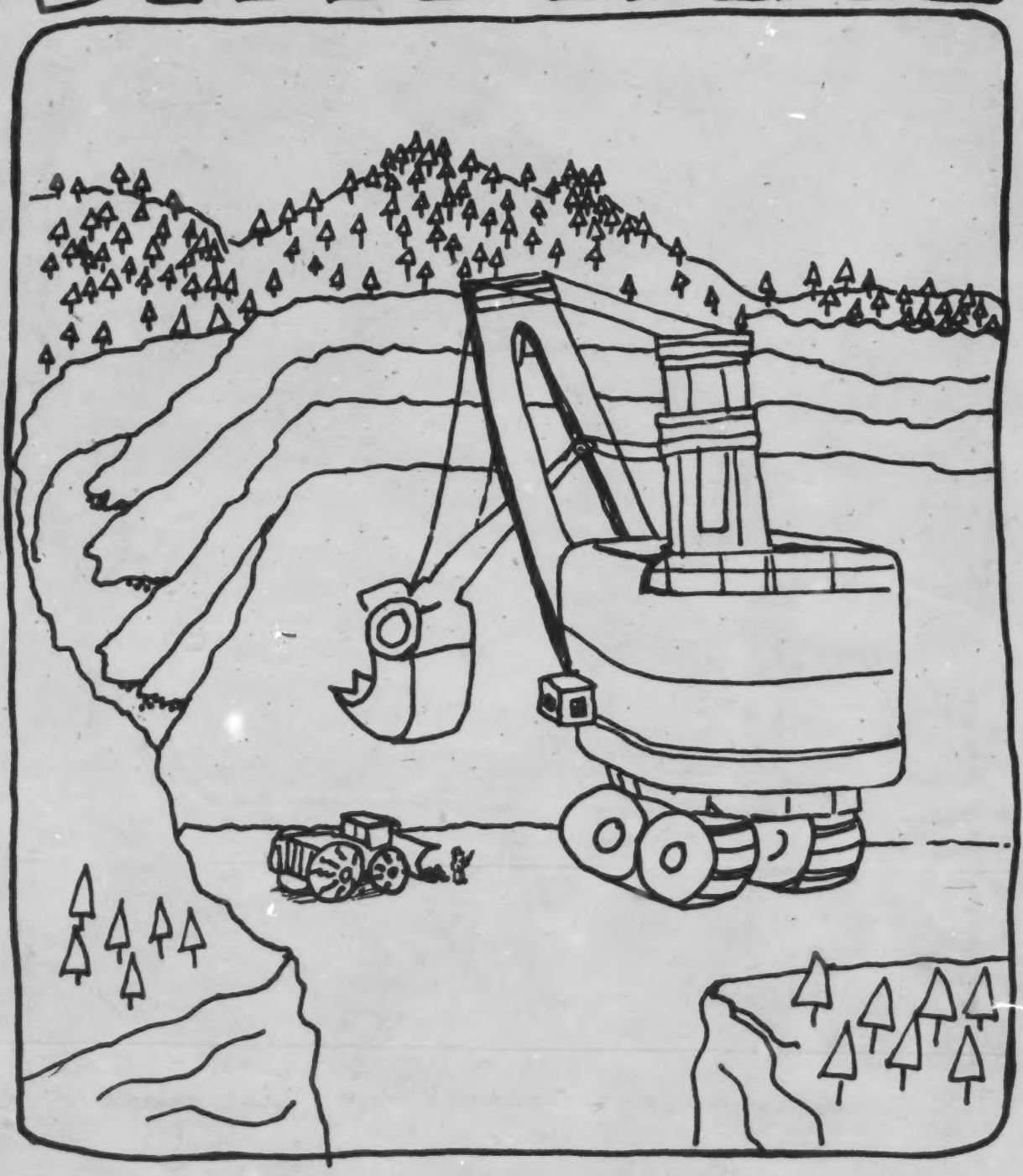
miner



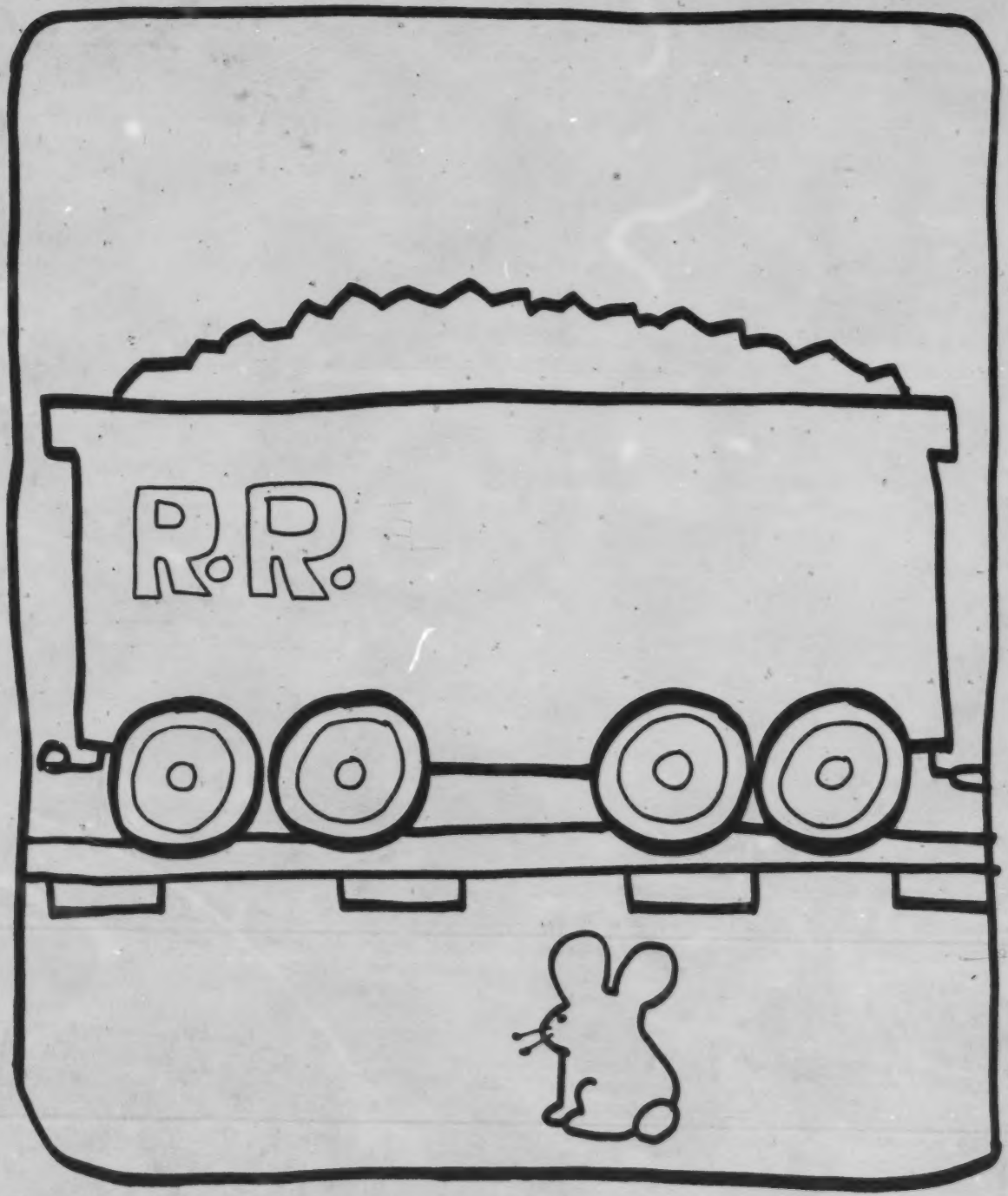
mining machine



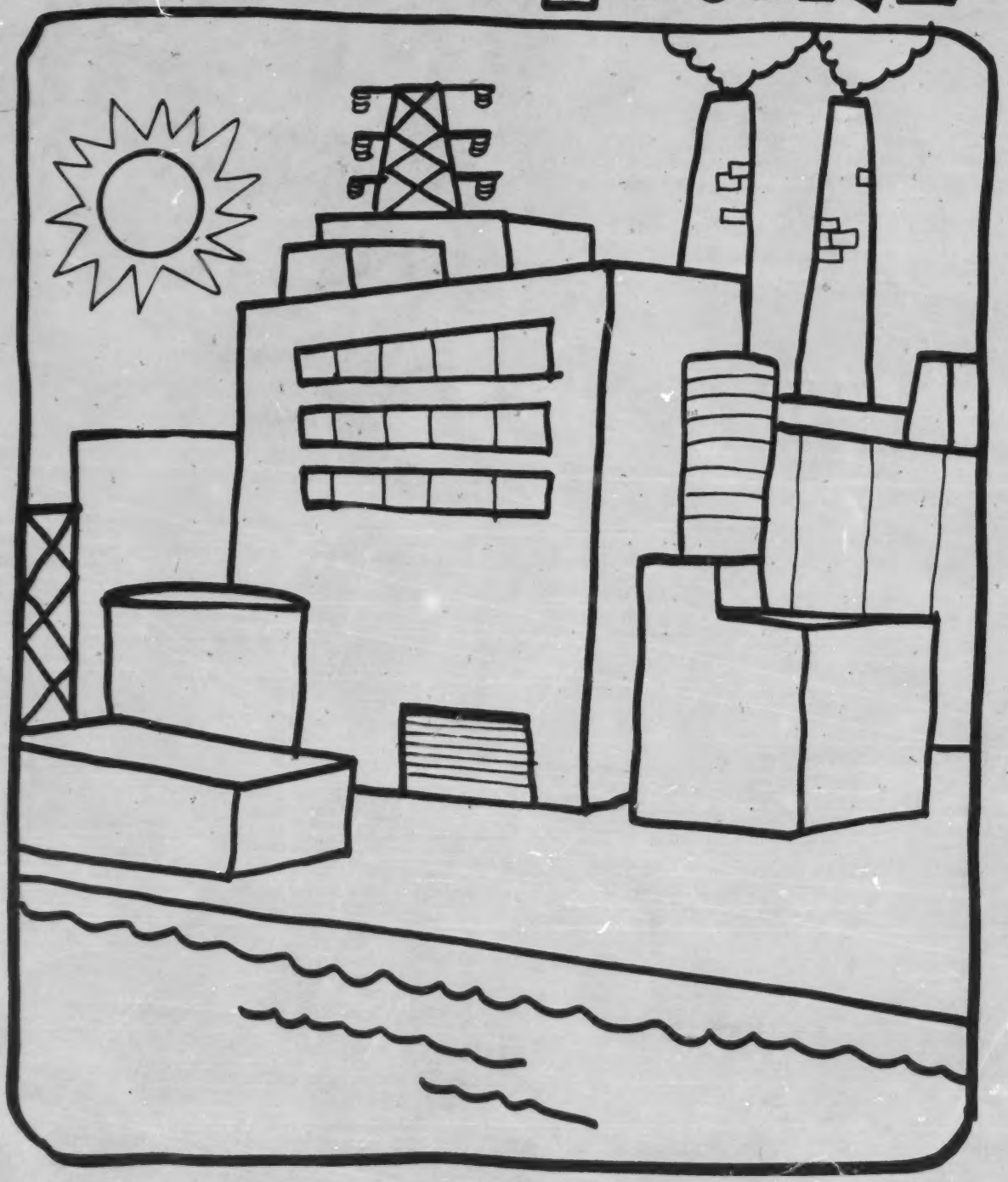
strip mine



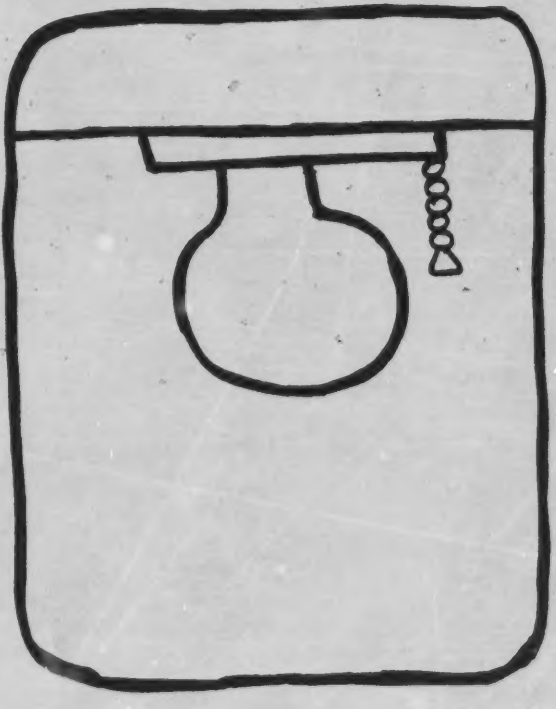
Coal Car



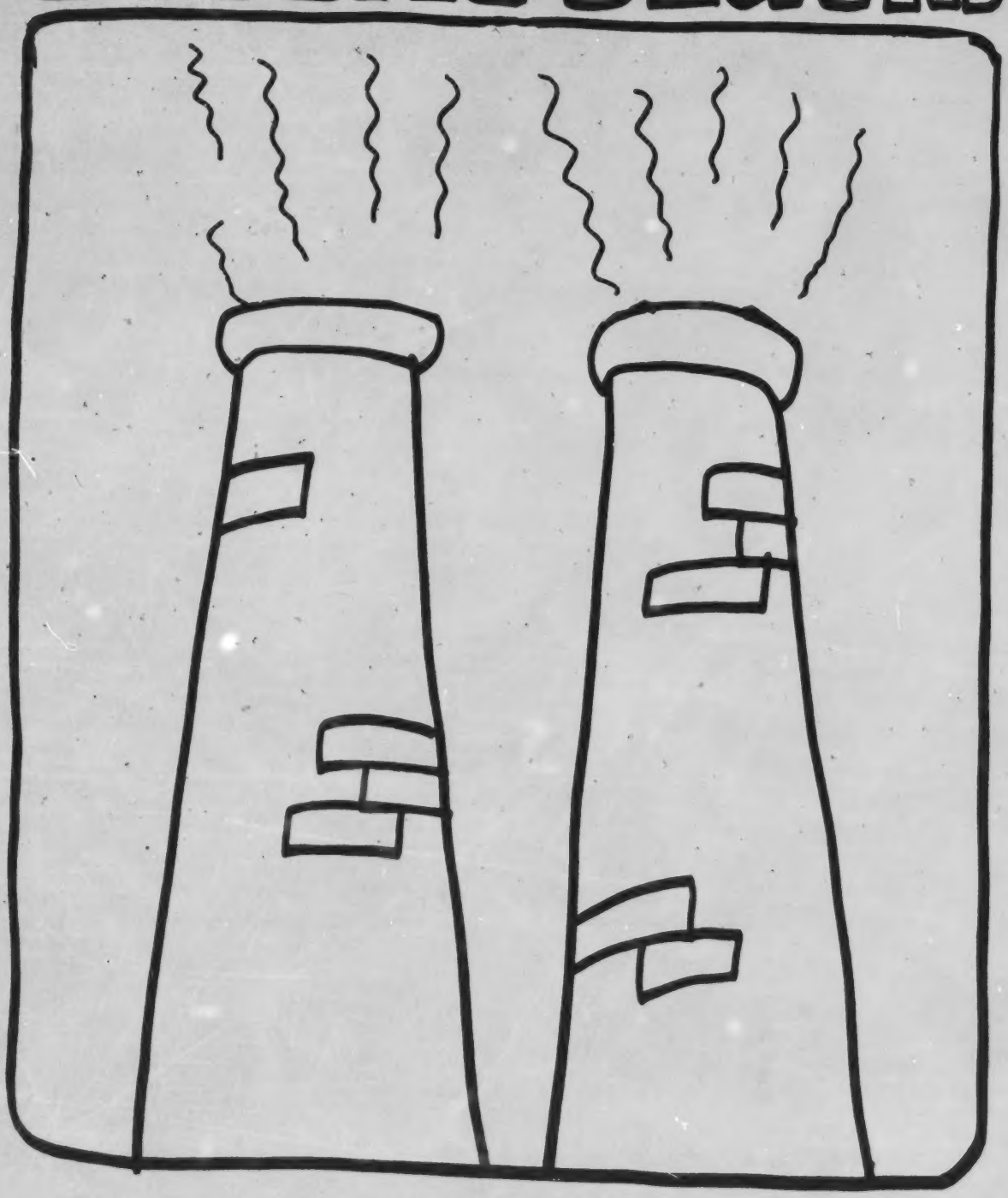
power plant



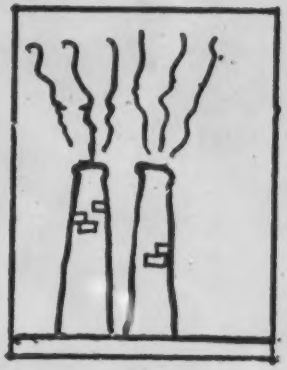
SOME COAL USES



smoke stacks



6
5
4
3
2
1



COAL

A-69

HOW TO TRAIN A TERRARIUM

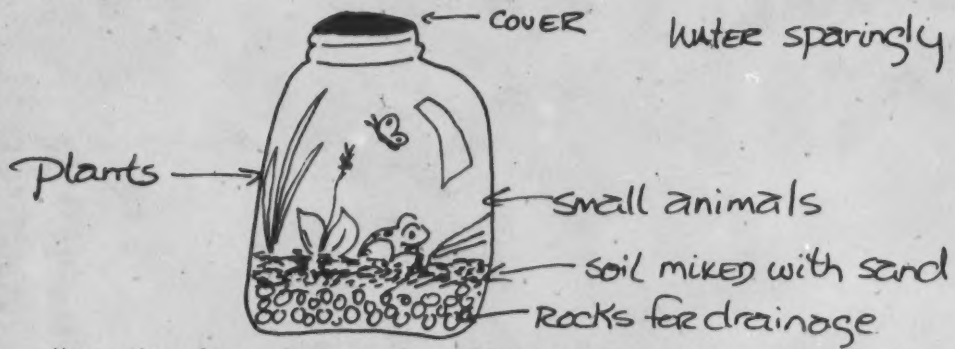
20

ACTIVITY:

The following shows two ways your students can make a terrarium.

Terrarium Number 1:

Have the class bring a clear container such as a large mouth jar in which to make a terrarium according to the following diagram:



Have the class observe the makers, eaters, and rotters (better known as producers, consumers, and decomposers) in their terrariums. Have them draw a food chain which illustrates their own terrarium on a large piece of paper using either words or pictures to represent each step.

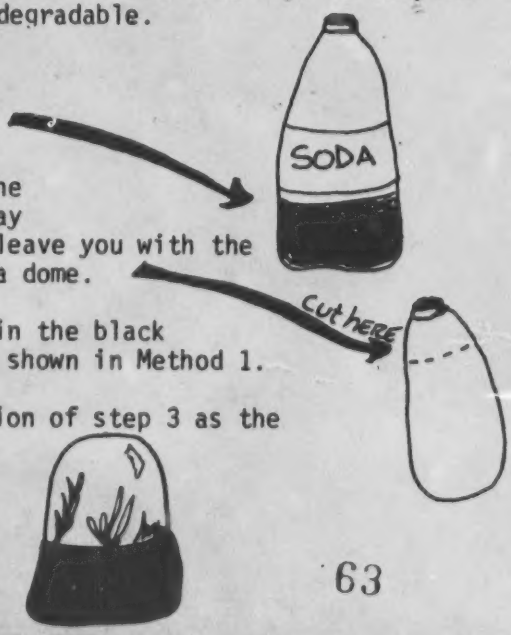
Terrarium 2:(Using this method illustrates ways to recycle material normally not biodegradable.
Step 1: Remove label

Step 2: Pry-off the black plastic bottom.

Step 3: Cut the top off the bottle about 1/3 of the way from the top. This will leave you with the bottom 2/3's which forms a dome.

Step 4: Make a terrarium in the black plastic bottom portion as shown in Method 1.

Step 5: Use the dome section of step 3 as the cover for the terrarium .



CONCEPT:

All living things are part of a food web and are dependent upon each other.

SUBJECT:

Art
Science

MATERIALS:

Glass jar or large plastic soda bottle
Soil
Pebbles
Variety of small plants
Water

ENERGY RELAY

21

CONCEPT:
Natural systems make maximum use of energy available.

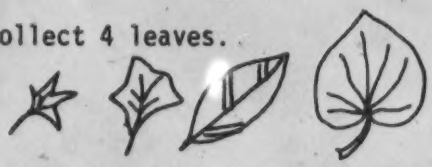
SUBJECT:
Science

MATERIALS:
Coffee can
Dried beans
Leaves

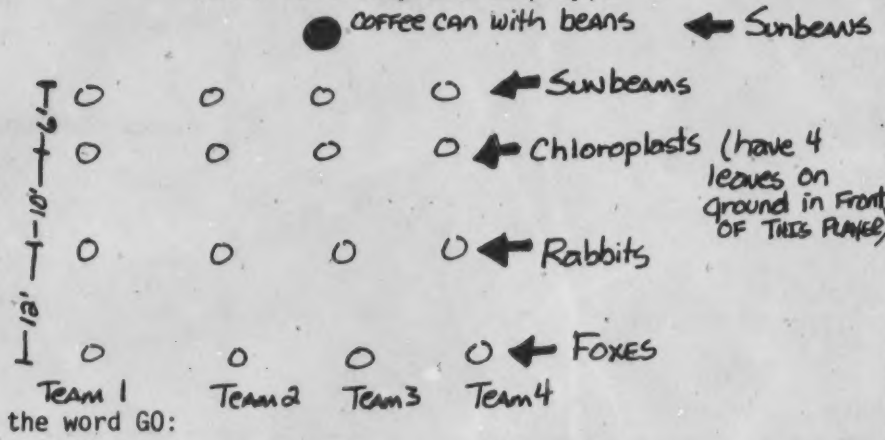
ACTIVITY:

Get students in groups of four:

Each group should collect 4 leaves.



Go to a field or yard and have each team set themselves up as follows: (be sure to assign each member of the team which role they are to play).



On the word GO:

Sunbeams carry sunbeans one at a time to chloroplasts.
(Sunbeans are the dried beans you have placed in a coffee can in the front of the sunbeams)

When chloroplasts have 5 beans, they pick up one leaf.

When chloroplasts have 2 leaves, they carry one leaf to the rabbit (it took one leaf worth of energy to carry it).

When the rabbit gets a leaf, it takes <u>one</u> hop towards the fox.

THE FIRST TEAM TO COMPLETE THE FOOD CHAIN BY REACHING THE FOX WINS!

Be sure to discuss with your class who was the most tired in this game and why.

MAKERS, EATERS, AND ROTTERS

22

ACTIVITY:

On a grassy area, have the class form a large circle. Have the students lie down with their feet pointed in towards the center of their "sun". Have them close their eyes and ask: "Do you feel energy from the sun? How does it feel?"

Have the children roll over and examine the grass. Ask them where the grass gets it's energy to grow. Explain that the green plants take energy from the sun and make food energy from which they grow. These will be known as the "makers".

Have the students look for grass eating animals in the same place. Ask them, "What other animals eat grass?" (rabbits, cows, people, etc.) These animals are called "eaters".

Place a piece of decaying log in the center of the circle. Have the children feel, smell, and examine a handful of decaying wood. Discuss with them how bacteria which is not visible use water and air to rot or decompose once living substances. These bacteria are constantly resupplying the soil with much needed humus and minerals for good plant growth. These shall be known as "rotters". Note that not all rotters are invisible. Show the students some form of fungi. These plants cannot turn energy from the sun into food energy and so they must decay once living matter in order to get the energy they need.

The following drawing shows the life cycle in simplified terms and can be used for the basic structure of a bulletin board or a teacher made study poster.

CONCEPT:

Living things are either makers, eater,s or rotters, all of which get energy from the sun.

SUBJECT:

Science

MATERIALS:

Rotting log or soil

ENERGY WORD FIND

23

ACTIVITY:

Pass out a copy of the "word find" and the reference list to each student. Have the students find the hidden words in the "word find" which are listed on the reference list.

This activity could be used in a learning center as a work sheet by reproducing it on a task card. A single reference list would be made available, as well as a self-checking sheet.

CONCEPT:

This activity can be used to reinforce basic energy concepts.

SUBJECT:

Science
Language Arts

MATERIALS:

"Word Find" sheet for each student
Reference list for each student

Taken from: Energy, Food, and You, Washington State Office of Public Instruction.

E	N	E	R	G	Y	H	L	W	I	N	D
W	A	T	E	R	P	O	W	E	R	O	K
O	P	T	S	A	I	L	B	O	A	T	W
S	A	X	U	O	T	U	A	S	I	Y	P
F	U	R	N	A	C	E	E	E	R	T	E
W	B	E	V	N	G	U	L	H	P	G	T
D	O	K	O	I	L	Z	S	R	L	I	R
X	C	O	T	M	S	U	F	H	A	K	O
C	R	F	D	A	T	R	A	I	N	M	L
U	O	S	P	L	S	N	C	L	E	F	E
N	T	A	F	S	P	L	A	N	T	S	U
Y	M	N	L	B	U	V	T	Z	X	L	M

WORD FIND

WORD FIND REFERENCE LIST

Energy - "The source of power that makes things work.

Sun - The source of most energy.

Plants - Converters of sunlight ot energy which can be eaten by animals.

Petroleum - Stored energy from ancient plants and animals.

Wind - Energy which comes from the sun heating the atmosphere around the earth.

Sailboat - A way to travel on water using wind power.

Water power - Energy that comes from the sun causing water to evaporate and cool down again, or the gravitiation force of falling water.

Airplane - Form of travel in the air that uses petroleum.

Auto - Form of travel on the ground that uses petroleum.

Train - Ground travel along tracks that uses petroleum, coal, steam, or electricity.

Furnace - Large stoves used to heat homes. The fuel can be coal, petroleum, water power, or wood.

Wood - Stored sunlight energy. It can be used around a campfire.

Tree - A plant which stores energy as wood.

Coal - Stored energy from dead plants and trees that have been tightly packed (under pressure) for millions of years.

Animals- Users and converters of energy from plants.

Oil - A more usable form of energy which comes from petroleum being distilled or processed.

Taken from: Energy, Food, and You, Washington State Office of Public Instruction.

ENERGY THINKER CROSSWORD

24

ACTIVITY:

Give each student a copy of the Energy Thinker crossword puzzle. When the students have completed the puzzle, discuss the answers with them.

This activity can be used as an enrichment activity in a learning center by making task cards and self check answer sheets.

CONCEPT:

This activity can be used to reinforce basic energy concepts.

SUBJECT:

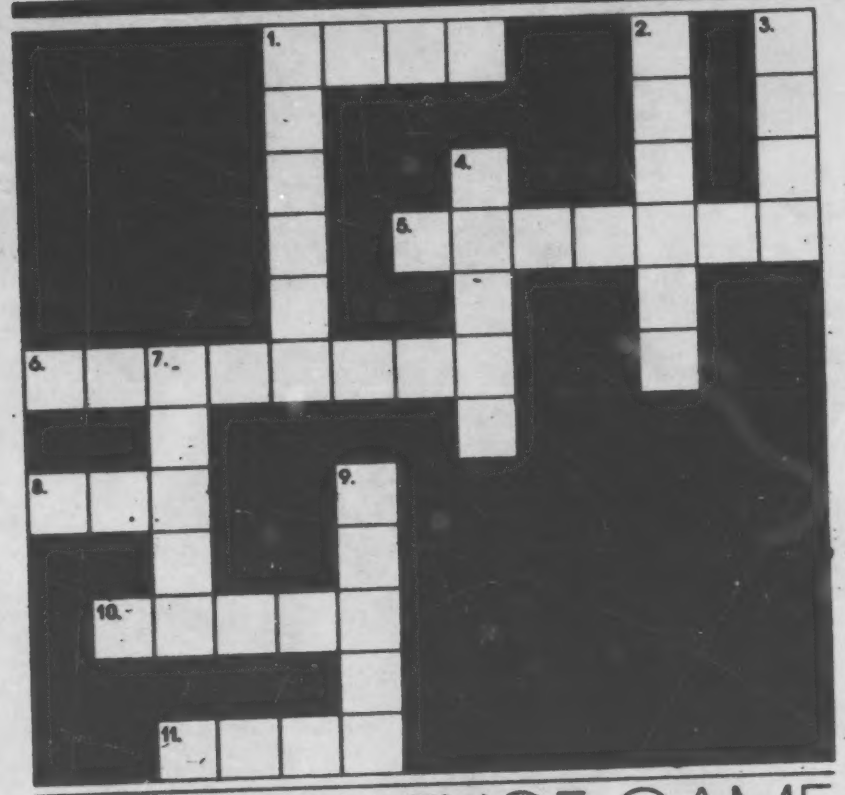
Language Arts
Social Studies
Science

MATERIALS:

Copy of puzzle for each student

69

ENERGY THINKER I



THE CHALLENGE GAME

TRY THE CHALLENGE GAME FOR SOME FUN WITH PHYSICS. YOU CAN FIND IT IN THE "GAMES AND OTHER NIFTIES" SECTION.

ACROSS:

1. You need ____ to give your body energy.
5. ____ gas can be pumped to your home for heating and cooking.
6. Fuel for automobiles is called ____.
8. The first successful ____ well was drilled in the United States in 1859.
10. The thick liquid that is pumped from underground pools is called ____ oil.
11. Nuclear energy is energy released when an ____ is split.

DOWN:

1. Coal, natural gas, and oil are called ____ fuels.
2. ____ is the power to make things move.
3. The Europeans were the first to mine ____ for heating.
4. In a steam engine coal is burned to heat ____.
7. Energy from the sun is called ____ energy.
9. When water boils, ____ is released to work for us.

ANSWERS:

ACROSS
1. Food
5. Natural
6. Gasoline
8. Oil
10. Crude
11. Atom

DOWN
1. Fossil
2. Energy
3. Coal
4. Water
7. Solar
9. Steam

From Energy Activities with Energy Out, Federal Energy Administration, Washington, D.C., 1975, p. 17.

HOW CAN YOU MAKE A MAGNET?

25

ACTIVITY:

Activity 1:

Have each student make a record sheet as shown below:

Day	Nail with 20 strokes	Nail with 100 strokes

Stroke each nail with a magnet.

Stroke the nail in one direction only, swinging your arm out so that the magnet is away from the nail on the return motion.

Stroke one nail twenty times and the other one hundred times.

Hold the nail that was stroked twenty times over a pile of 12 paper clips. How many clips will be picked up as you bring the nail straight down on the clips? Record the answer.

Repeat #5 with the nail that was stroked one hundred times. Record this answer.

To find out how long this magnetic effect lasts, test the magnets for three days and record the results. Discuss the results.

Drop the nail magnets on the ground after restrengtheneing them on the magnet. How many clips was the dropped nail able to pick-up? Compare this number with the amount on Day 1 of the record sheet.

Activity 2:

Using two magnets, loop rubber bands over the four poles. With a piece of string, tie one end of it to each end of a magnet as shown below. Taking a second piece of string, tie it to the center of the string holding the magnet. Be sure not to drop the magnet.

Repeat the steps with the second magnet.

Suspend the magnets so that they can swing freely.

CONCEPT:

Students will become aware of energy flows in natural systems.

SUBJECT:

Science

MATERIALS:

Per student or student group:

2 large iron nails
12 steel paper clips
2 large bar magnets
4 pieces of string
4 rubber bands
Crayons or colored pens
Copy of the magnet pattern per student or student group

25

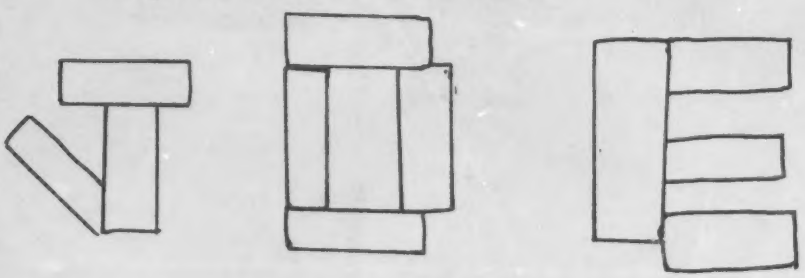
ACTIVITY:

Activity 2 (continued):

Place the magnets next to each other with the N ends towards each other. What happens? Now place the S end of one next to the N end of the other. What happens?

Discuss with the students the concept of magnetic energy in the natural system.

Using what you have learned about how magnets interact, color in the ends of the magnets in the picture below as they would have to be to form the letters. Color all north poles blue and all south poles red. Have the students make a magnet picture of their name.



Additional activities:

Have the students go around the classroom finding different materials and see which ones the magnet will become attracted.

Find out how strong the magnetic pull is by seeing at what distance the magnet can pick-up objects, or through what thicknesses it will still be able to move objects.

CONCEPT:

SUBJECT:

MATERIALS:

ENERGY PASSWORD

26

ACTIVITY:

1) Write the following words on individual flash cards.

turbine	magnet	volt
steam	circuit	watt
battery	wind	kilowatt
generator	water	electron
generate	heat	neutron
electricity	light	charge
energy	quantity	positive
conversion	available	negative
convert	friction	produce
source	detect	reaction
power	dectector	compass
current	insulated	appliances
static	instrument	conserve
experiment	coil	waste

2) Divide the class into two groups of approximately equal ability. Choose one student form each team to give clues and have them sit at the front of the room. The game is played like the TV game "Password" except that each clue giver will be giving clues to his team rather than to one partner.

3) Use the list of suggested words included, or add your own. (The students should be familiar with words before the game is plaed.)

4) -Each of the clue givers is shown the password.
-The clue givers them give one word clues alternately to their teams, without using any form of the word in the clues.
-After giving a clue, the clue giver chooses someone on his team to guess what the password is. If that team member guesses the correct word, his team scores, and you begin a new round using a new password.
-If the team member quesses incorrectly, the turn goes to the other clue giver, who gives a new clue and chooses someone from his team to quess.
-After the word has been guessed correctly by one team or the other, the new word goes first to the clue giver who did not start the previous round.

Scoring

10 points for the team guessing the word correctly on the first clue; 9 points if the correct word is guessed on the second clue; 8 points on the third etc..

New clues should be chosen from each team after every three or four rounds.

CONCEPT:

The students will become familiar with energy terminology and meanings.

SUBJECT:

Science
Language Arts

MATERIALS:

Flash cards

ENERGY BELIEVE IT OR NOT

27

ACTIVITY:

1) Put the following on the board:

   a. A flea has the muscle energy to leap more than 100 times it's body length.
   b. The roots of some trees have the power the split huge rocks.
   c. A cheetah can run at a speed of 65 miles per hour.

   These are just a few interesting and unusual facts about energy. See how many more you can find using encyclopedias, The Guiness Bood of World Records and other Science materials.

2) Have the students make an Energy Believe It or Not booklet and share it with their classmates. Illustrate each energy fact for your booklet to make it fun to look at and interesting.

CONCEPT:

Students will discover interesting and unusual facts about energy.

SUBJECT:

Science
Art

MATERIALS:

Art paper
crayons
Encyclopedia
Guiness Book of World Records
Reference books

SECTION II: THE FUEL AND THE FLOW . . . WHERE DOES IT GO?

These activities explore the various types of energy sources available for human use. A great deal of these activities emphasize the various renewable source of energy and encourabe students to build and make workable models for demonstration.

WINDOW SILL GARDEN

28

ACTIVITY:

1) Have the students bring from home a variety of containers such as cardboard mike cartons, coffee cans, egg cartons etc. to be used for "planters".

2) Obtain a variety of seeds from reliable sources. Herbs such as mint, rosemary, sage, etc. are particularly appropriate for classroom learning because they are small, fragrant, and can be used in a number of other activities. (See Activities #31 and #32).

3) Each student should fill his/her container about 7/8 full of rich potting soil. Several seeds should then be place on the surface and covered with a 1/8 inch layer of soil and lightly watered. Place one set of plants in total darkness, the other in the windowsell.

4) Be sure to keep both sets of plants moist.

5) After two weeks, discuss the appearance of the plants grown in the light and the plants grown in the dark. Those grown in darkness should show a considerable amount of growth but will be weak stemmed and very pale in color. Be sure that the student answers the questions: "Should plants be grown in sunlight? On they grow in darkness? What differences are observed between the two?"

6) Let all the plants grow on the windowsell now, transplanting them to larger containers if they need more space.

CONCEPT:

Students will become aware of the link between the sun and growing healthy plants.

SUBJECT:

Science

MATERIALS:

Planters
Seeds
Soil

DRYING HERBS

29

ACTIVITY:

Heat from the sun can be used by man not only to grow food but also to preserve it.

1) Discuss with students the differentherbs and spices we use in our food when cooking. What different kinds can they think of?

2) Obtain some fresh herbs such as mint, parsley or basil. Wash the leaves and blot dry in paper towels.

3) Place the leaves in a paper bag and hang it in a sunny area. Herbs are dry when they become brittle.

4) Have the students taste the difference (or ask if there is a difference) between the fresh and the dried herbs. Let them take some home to cook in a meal, or use them in Activity #32.

5) Be sure to keep dried herbs in a sealed airtight jar so as not to lose the flavor.

Fruits and vegetables can also be dried in a sunny windowsell or on a heater by placing thin slices of them on a piece of foil and exposing to the heat source.

CONCEPT:

Students will understand that the sun can be used directly to preserve food.

SUBJECT:

Science

MATERIALS:

Variety of herbs or spices
paper towels
water
paper bags
airtight jars.

TEA PARTY

30

ACTIVITY:

1) Place dried mint, rosehip, or camomile leaves in a large glass jar. Add two tablespoons to every four cups of water.

2) Put an airtight lid on the jar and shake it.

3) Place the jar in a sunny location early in the day. Have a child shake the jar every 15 minutes or so. (This is done in order to give all the children a chance to help make the tea.)

4) At the end of the day strain the tea and sweeten it to taste. It is now ready to drink.

*If you use fresh leaves you will need twice the amount of leaves the recipe for dried calls for.

**See Activities #30 and #31.

CONCEPT:

The sun's energy can be used to heat water.

SUBJECT:

Science

MATERIALS:

Dried leaves (mint)
large jar with airtight lid
Sweetener
Cups for students

SOLAR HOT DOG COOKER

31

ACTIVITY:

The activity on the following pages shows how to construct a solar hot dog cooker. After the solar cookers are constructed discuss with your students the following questions:

What are some other foods that could be cooked with this cooker?

What are some foods that you may buy in stores that are cooked by the sun? (i.e., raisins, beef jerky)

What is the meaning of "dehydration"?

How can dehydration be used to preserve foods? Refer back to the DRYING HERBS activity.

Taken from:" Science Activities in Energy", U.S. Dept. of Energy, Oak Ridge, TN.

CONCEPT:
Solar energy can be concentrated for practical purposes.

SUBJECT:

Art
Science
Industrial art
Home Economics

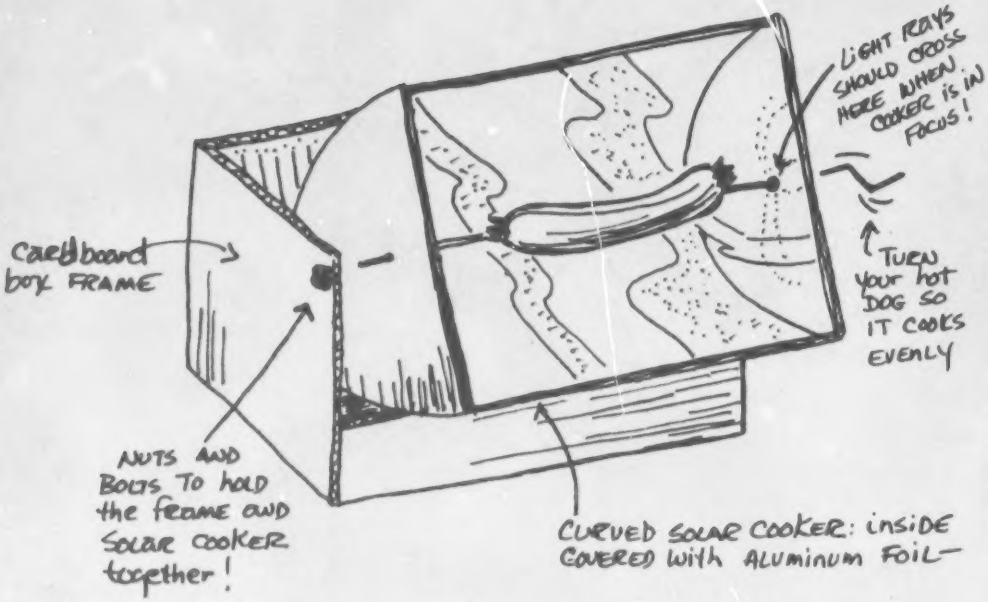
MATERIALS:

Cardboard boxes
Aluminum foil
Coat hanger per cooker
Thumbtack per cooker
String
Pencil
2 Small nuts and bolts per cooker
Rubber Cement

SOLAR HOT DOG COOKER (continued)

31

ACTIVITY:


LIGHT RAYS SHOULD CROSS HERE WHEN COOKER IS IN FOCUS!
TURN YOUR HOT DOG SO IT COOKS EVENLY
Cardboard box FRAME
NUTS AND BOLTS TO HOLD the frame and SOLAR COOKER together!
CURVED SOLAR COOKER: inside COVERED with ALUMINUM FOIL

CONCEPT:

SUBJECT:

MATERIALS:

31

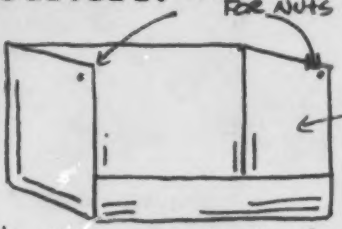
CONCEPT:

SUBJECT:

MATERIALS:

ACTIVITY:

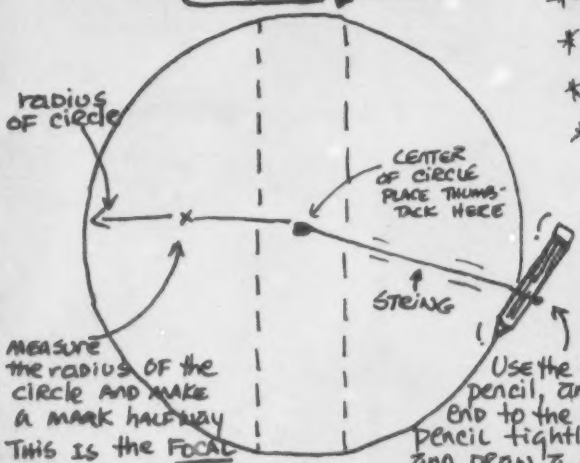
STEP 1.



Cut the top and FRONT out of a cardboard box to make a FRAME for your solar cooker!

STEP 2:

Make 2 large cardboard circles like this

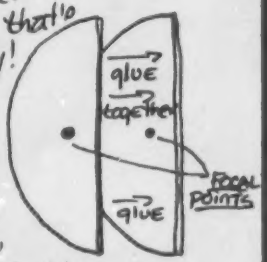

radius of circle
CENTER OF CIRCLE PLACE THUMB-TACK HERE
STRING
MEASURE the radius OF the CIRCLE AND MAKE A MARK HALFWAY THIS IS THE FOCAL Point OF your SOLAR Cooker.

Use the string to hold the pencil, and attach the other end to the thumbtack. Hold the pencil tightly, straight up AND DOWN, AND DRAW a circle on a piece OF cardboard! Then, cut apart as shown.

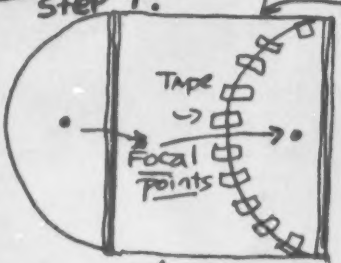
STEP 3:

Now, glue 2 pieces together to MAKE ONE that is twice as heavy!

Do this with both circles you cut!



Step 4:



TAPE another piece OF cardboard to the CURVED edges OF the 2 half circles you GLUED together — the width OF the piece OF cardboard should be slightly less than the width OF the box you cut to make a frame!

Then, COVER the INSIDE OF this piece with aluminum foil - USE RUBBER CEMENT!

COVER all INSIDE with ALUMINUM FOIL!

CLEAN WATER FROM THE SUN

32

ACTIVITY:

Fill a pan to a depth of 2 inches (5 cm) with muddy water.

Place a glass in the middle of the pan and cover the pan with clear plastic, taping the plastic firmly. It may be necessary to place a weight in the cup to keep it from floating.

Put a rock on the plastic wrap to make it sag in the middle but don't let the rock touch the cup.

Place the pan in a warm location and as th water evaporates notice the tiny drops that condense. Discuss condensation with your students. What happened to the mud?

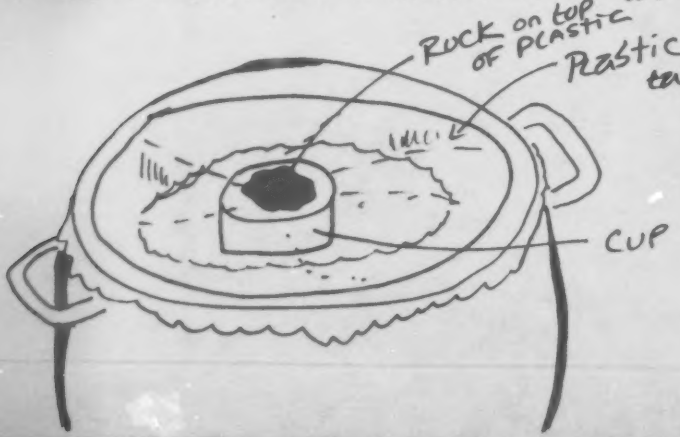
Try this experiment with salty water. Do you get more clean water than from the muddy water? Is this a good way for your city to get pure water to drink? Does mud or salt evaporate?

Check to see how clean your water is by placing several drops of muddy or salty water on the curved bottom of a plastic cup. Do the same with a few drops of clean water. After the water evaporates from both cups, notice if any residue is left behind.

Try making salt by evaporating seawater. In a large flat pan, pour a measured amount of seawater. (To make seawater add one teaspoon salt to one cup water.) Allow it to evaporate. Keep adding measured amounts until the salt forms crystals. Weigh the dry salt. How much seawater did it take?

Discuss the water cycle with the students. Have them make a large poster showing the directions water takes from oceans to clouds to rivers to ocean.

Taken from: American Museum of Science and Energy, Oak Ridge,TN



CONCEPT:

Students will be introduced to the concept of heat transfer and the water cycle.

SUBJECT:

Science
Math

MATERIALS:

Large pan or tub
Clear plastic food wrap
Rock
Masking tape
Muddy water
Salt water
Drinking cup or glass

ENERGY FROM THE SUN

33

ACTIVITY:

1) The students are asked to line 2 boxes the sam. size and shape with different coverings. One box should be covered with black paper and the other box should be covered with aluminum foil. A thermometer with same reading is placed in each box and they are set in the sun for ten minutes. A comparison is made of the different temperatures. How does color of roofing affect heating and cooling? How does the color of the clothes you wear in the summer and winter affect the heat retained and lost?

2) Students could line the box with black paper and cover it with black paper. Line the box with aluminum foil and cover it with aluminum foil. Follow the same procedure above. Relate it to types and colors of home coverings and insulations.

3) Have the students research how the sun affects the formation or availability of energy sources. Illustrate this information in a mural made by the class.

4) Show the film "Our Mr. Sun, Parts I & II". Discuss the importance of the sun and the fact that all life on earth depends upon the sun. It is our original source of heat and light energy.

CONCEPT:

Students will see the effects of colors and materials on the rate and amount of absorption and relation of the sun's rays.

SUBJECT:

Science
Art

MATERIALS:

Boxes
Thermometers
Black Paper and other colors
Aluminum Foil

SUN AND SHADE

34

ACTIVITY:

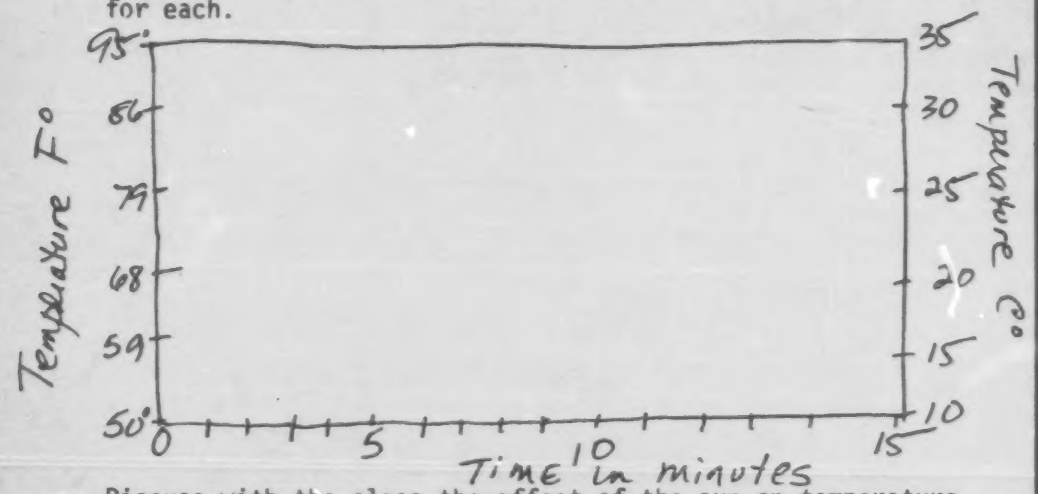
Pour equal amounts of cold water into two styrofoam cups.

Place a thermometer in each cup.

Set one in the sun and the other in the shade.

What is the temperature of each cup after 5, 10 and 15 minutes?

Make a graph like the one below and use it to record the temperature each minute for 15 minutes. Use different markers for each.



Discuss with the class the effect of the sun on temperature. Would the water in the cup get warm on a cloudy day? On a cold but sunny day?

CONCEPT:

To understand the effects of the sun on temperature.

SUBJECT:

Science
Math

MATERIALS:

per student:
2 styrafoam cups
2 thermometers
watch

WHICH MATERIAL STORES SOLAR ENERGY THE BEST?

35

ACTIVITY:

Fill the cans and place a thermometer in each one.

Paint the box black, and put the cans in the box.

Now remove the cans and watch the temperatures fall.Stir occasionally. Which temperature falls the slowest? Which stores solar heat best?

PLACE the CLOSED Box in the SUN for ½ hour!

CONCEPT:

To understand the effects of the sun on temperature

SUBJECT:

Science
Math

MATERIALS:

per student group:
cardboard box
black paint
4 small metal cans
4 thermometers
sand, salt, water, and torn-up paper

86

SUNNY SIDE UP

36

ACTIVITY:

Often people think that we have summer because the earth is closer to the sun. It is true that the earth does orbit closer to the sun, but this happens during the northern winter. The real reason, of course, is that earth tilts on it's axis and therefore one part of our world gets more concentrated sunlight. This is enough to make the difference between summer and winter. You can prove it with a tin can.

Teacher preparation:

Cut the top and bottom out of a tin can. Paint them dull black with poster paint. Roll some clay balls for stands.

Student action:

Tape a thermometer to the center back of each lid. Set the lids up so that one faces the sun squarely. Put the other so that it receives the suns rays at a slant. Think of them positioned on the globe.

After about ten minutes compare the temperature difference. Which one is summer?

Discuss the relationship the students found in the temperature with seasonal change.

Demonstrate the relationship by taping the lids to a globe as illustrated below and change the position of the "sun" by using a flashlight beam.

CONCEPT:
To discuss the difference between direct and indirect solar radiation.

SUBJECT:

Science
Social Studies

MATERIALS:

Tin cans
Can opener
Clay balls
Paint brush
Black poster paint
Thermometers
Tape
Globe
Light source

HOW FAST CAN YOU BURN PAPER

37

ACTIVITY:

1) Position a magnifying glass so that the suns' rays focus the smallest amount of light on a piece of dark or black lighweight paper. How many seconds does it take before the paper starts to smoke?

2) Cover the lens with a piece of black construction paper that has a 3cm hole cut in the center. How long does it take this time? Try this with different colors of construction paper.

3) Is it possible to boil water this way? Solder melts at a low temperature for metal, do you think you could melt solder with a magnifying lens? Would a glass container filled with water be able to do the same thing? Try it.

4) How much more sunlight does the uncovered lens let in as compared to the covered lens? Draw a circle that is the circumference of the uncovered lens on a piece of graph paper or grid. Now draw a circle that is the same circumference as the covered lens. Count the number of squares and parts of squares that each circle covers. How do these numbers compare? Does this explain your results? Would this exercise be more accurate if your grid was on a ½cm scale.

CONCEPT:

Students will learn about the effects of color on the absorption of the suns' rays.

SUBJECT:

Science

MATERIALS:

1 6cm or larger magnifying glass
Paper and scissors
Watch
Black construction paper
Dark or black lightweight paper
Colored construction paper
Graph paper or grid
Glass contain

83

THE LEGEND OF THE SUN

38

ACTIVITY:

Discuss some ways that the sun helps us, especially heat and light. Distribute the story "How the Sun Made A Promise and Kept It" and read it with your students.

After discussion about the story and the characters have students research other literature which contains myths and legends about the sun. (ie., Greek mytholgy, Aztec stories,)

Have students draw a large class mural which depicts the actions in the story.

Taken from: Connections, A Curriculum in Appropiate Technology, 1979.

CONCEPT:
To read and discuss the historic and religious factors in which the sun has played in myths and legends of cultures.

SUBJECT:

Language Arts
Art

MATERIALS:
per student:

a copy of "How the Sun Made a Promise and Kept It"
Drawing paper, crayons, pencils

HOW THE SUN MADE A PROMISE AND KEPT IT

Long, long ago, the god Weese-ke-jak made the earth and the sky. There were oceans and lakes. There was dry land. Weese-ke-jak made birds to fly in the sky. He made fish to swim in the oceans and lakes. He made animals to lie on the land. The earth was a beautiful place. But cometimes it was not a good place to live. In those days, the sun went wherever he wanted to go. He only visited the earth sometimes. When he was away it was dark and cold.

"I must do something," thought Weese-ke-jak. "We need the sun to light and warm us." Weese-ke-jak thought and thought. At last he had a plan.

"The next time the sun visits the earth," Weese-ke-jak said, "I will catch him in a net. I will keep him close to the earth. Then the earth will always be warm and light."

Weese-ke-jak made a net out of ropes. The net was very large and strong. Then Weese-ke-jak waited. When the sun came near the earth again, Weese-ke-jak took his net. He swung it around and around. Then he threw it up into the sky. The net dropped over the sun. The sun was caught. The sun pushed and pulled. But he could not free himself.

"Let me go Weese-ke-jak," begged the sun. "Let me go! Why do you keep me in this net?"

"I have trapped you so that I can keep you near the earth," answered Weese-ke-jak. "Now the earth will be warm and light all the time."

And Weese-ke-jak would not let the sun go.

But Weese-ke-jak had made a great mistake! He had pulled the sun too near the earth.

It began to get hotter and hotter. Soon it was so hot that the birds flew down out of the sky to see what had happened. The animals came out of the forests.

"If it gets any hotter," thought Weese-ke-jak, "Everything will begin to burn. I must let the sun out of the net. Maybe I can make him a promise not to go too far away."

Then Weese-ke-jak called to the sun.

"I feel sorry for you and I might let you go. But you must promise something."

"I will promise anything you say, Weese-ke-jak," answered the sun. "Just let me go."

He pretended htat he still wasn't sure he should let the sun go.

"I will keep my promise," cried the sun. "What must I do?"

"You must never go too far away," said Weese-ke-jak. "You may come close to the edges of the earth, but only in the morning and in the evening. During the day you must come just near enough to warm the earth."

"I will do as you say," said the sun. "Now please let me go!"

Weese-ke-jak went over to free the sun. But it was so hot that he could not get near the net.

So Weese-ke-jak called to the animals.

"I cannot get close to the sun," he said. "Can anyone help me?"

A few of the animals were brave. They tried to help Weese-ke-jak.

First Deer tried to free the sun. Then Fox tried. They could not come near enough. It was too hot.

Then Beaver came. "I will try," he said.

HOW THE SUN MADE A PROMISE AND KEPT IT
(Continued)

In those days, Beaver did not look like he does now. He had only a few small teeth. His fur was rough and prickly. He was not very handsome. But he was brave.

Beaver ran to the net. He quickly began to bite the ropes that held the net. It was very, very hot. But Beaver did not give up. At last, Beaver bit through the last rope. The sun was free. It rose up from the earth like a balloon.

The earth became cooler.

Weese-ke-jak and the animals were happy. They ran to thank Beaver. Poor Beaver! He was not happy. The heat from the sun had ruined his coat. He had almost no fur left.

"Don't be unhappy, Beaver," said Weese-ke-jak, "Because you were so brave, I will give you two gifts."

Weese-ke-jak gave Beaver a new coat. The coat was smooth and soft. He gave Beaver a new set of fine sharp teeth.

But Weese-ke-jak did not put any fur on Beaver's tail.

"Beaver's tail will always be bare," saif Weese-ke-jak, "So everyone will know how brave he was. They will remember that he set the sun free."

As for the sun, although he was free from the earth, he was not free from Weese-ke-jak's net. It still hangs over him.

Look carefully at the sun in the morning or in the evening when it is close to the earth. Look and you will see the long ropes hanging from the sun. The ropes remind the sun of his promise to Weese-ke-jak.

And in all the days of the world since then, the sun has kept this promise.

RACE FOR THE SUN

39

ACTIVITY:

1) Go outside with your class and have the children cluster around you. Have everyone raise their arms and pretend to be trees.

2) Remind the class that as trees each of them is competing for the sun. Illustrate competition by towering over the smaller trees and gently bumping them out of the way with a little hip action.

3) Explain how larger trees reach more sun and therefore obtain more energy for making food. By obtaining more food they are able to grow even larger while the smaller trees lose the "race" and get bumped out of their place in the forest.

4) Discuss how other animals compete for energy. (adaption)

5) Be sure to discuss how man competes for energy too and that "large" countries (industrial) use more energy thus pushing out smaller countries from the "survival game."

6) Discuss the concept of adaption which helps some plants and animals to more "energy efficient" and therefore able to compete with larger competitors. (Vines, cacti, fleas etc.)

CONCEPT:
Students will learn about the concepts of competition, adaption, and succession in the natural world.

SUBJECT:

Science
Social Studies

MATERIALS:

SHINE ON MOBILE

40

ACTIVITY:

Discuss various sources of energy, relating them back to their primary source - the sun.

Have the students cut-out pictures to bring to class which show different ways in which the sun helps us.

Have the children trace energy forms back to the sun.
For example: Where does oil come from? - - organic matter
Where does organic matter come from? - - plants
How do plants grow? - - from sun, soil, and water.

Make a large orange sun by cutting it out of posterboard and coloring. On each ray print a different form of energy from the sun. For example: wind, tides, water power, gasoline,oil, wood, coal, food, solar, natural gas.

Hang crepe paper from the back with bells on the end so that they blow in the wind. The crepe could be the colors of the rainbow.

Hang the sun outside, in an open window, or the the ceiling of the classroom.

Taken from: Energy,Food, and You, 1977.

CONCEPT:
All forms of energy are derived from the sun.

SUBJECT:

Science
Art

MATERIALS:

Poster board or tagboard
Scissors
Crepe paper
Bells
Decorations for the sun such as yarn.

SOLINGO

41

ACTIVITY:

Teacher preparation:

Duplicate a blank bingo sheet for each student.

Make new bingo cards by rotating the order of at least one vertical column on each card so not two cards are alike.

Duplicate and mount answer cards on index cards.

Game Instructions:

Designate a caller who will read the energy related clues to the other students.

As the clue is read the player will place the bingo chips in the correct answer box.

The first player to get five boxes in a horizontal, vertical, or diagonal row calls out "Solingo" and is the winner!

The caller should check to be sure the winner's card is correct. If the students' card is not correct he or she is eliminated and the game continues.

The winner assumes the responsibility of calling the next game.

CONCEPT:

Students will use classification skills in a energy flow game.

SUBJECT:

Science
Social Studies

MATERIALS:

Per student:
Solingo boards
Solingo cards
Solingo chips (buttons

94

SOLINGO

ENERGY CLUE

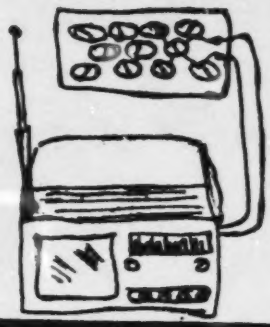
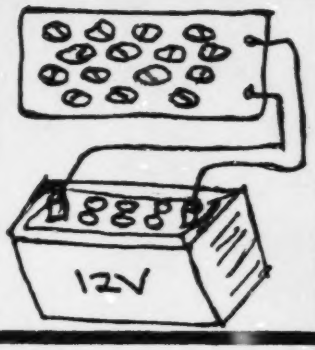
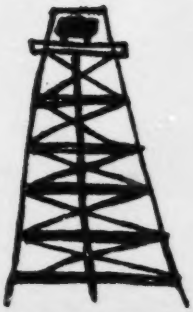
General Information	Solar Energy Storage	Solar Energy Chain	Solar Energy Products
Distance from earth to the sun	Solid	Energy Source	Television
Third planet from the sun.		Converters of Solar Energy	Power Tools
Distance from earth to the moon	Liquid	1st Order Consumer (Plant-eaters)	Go-Cart
Planet receiving least amount of solar energy	Gas	2nd Order Consumer (Eats other animals)	Battery

SOLINGO
BOARDS

General Information	Solar Energy Storage	Solar Energy Chain	Solar Energy Products

96

Answer Cards

			
93,000,000 Miles	Pluto		
250,000 Miles			
Earth			

ENERGINGO

42

ACTIVITY:

Teacher preparation:

Duplicate blank bingo sheet for each student.

Make new bingo cards by rotating the order of a least one vertical column on each card so no card is exactly alike.

Duplicate and mount answer cards on index cards.

Game Instructions:

Designate a caller who will read energy related clues to the other students.

As the clue is read the player will place the energingo chip in the correct answer box.

The first player to get five boxes in a horizontal, vertical or diagonal row calls "Energingo" and is declared the winner.

The caller should check to be sure the winners card is correct. If the student is not correct he or she is eliminated and the game is continues.

The winner assumes the reponsibility of calling the next game.

CONCEPT:

Energy flow in a community

SUBJECT:

Science
Social Studies

MATERIALS:

Per student:
Energingo board
Energingo cards
Energingo chips(buttons

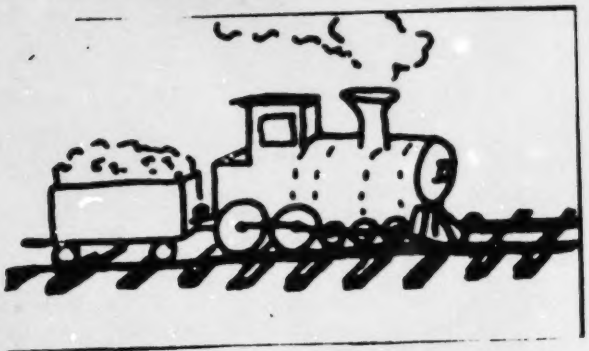
ENERGINGO

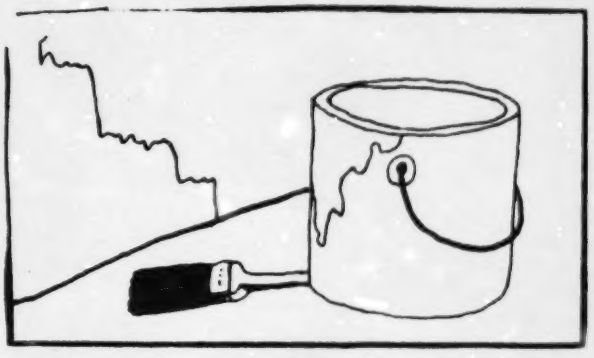
ENERGY CLUE

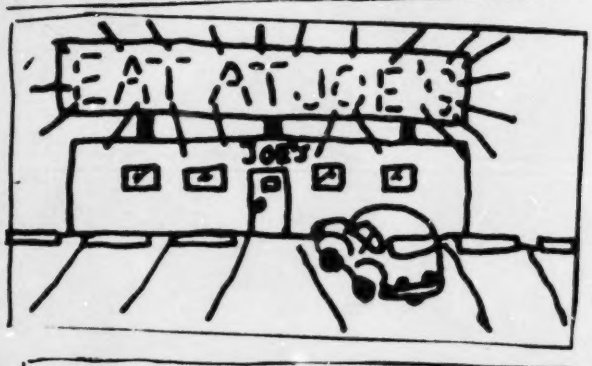
Coal	Gas/Oil	Solar	Electric	Oil
Steam-engine	Gas Stove	Flower	Air-conditioner	Car
Charcoal	Hot water Heater	Person	Neon Sign	Boat
Pot-bellied Stove	Shirt	Free	Lamp	Bus
Paint	Umbrella	News-paper	Traffic Light	Asphalt
Records	Blanket	Pear	Toaster	Airplane

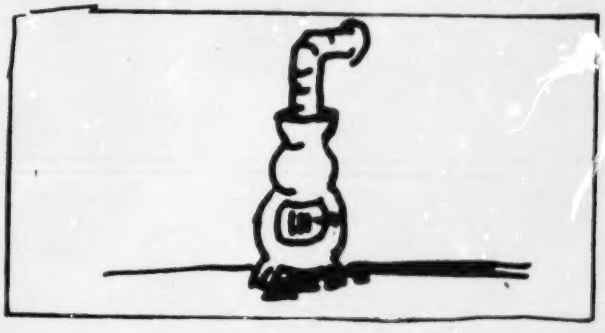
ENERGY BINGO BOARD

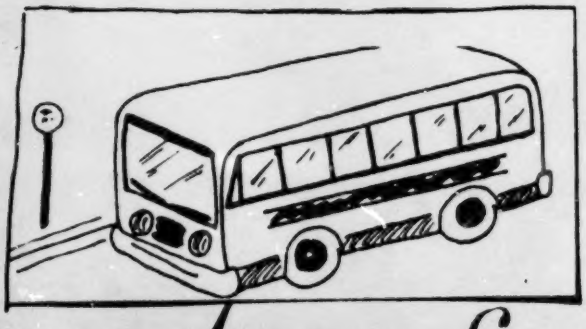
Coal	Gas/Oil	Solar	Electric	Oil
		Free		



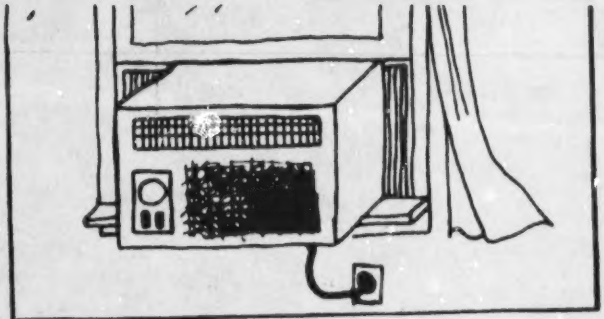



EAT AT JOE'S
JOE'S



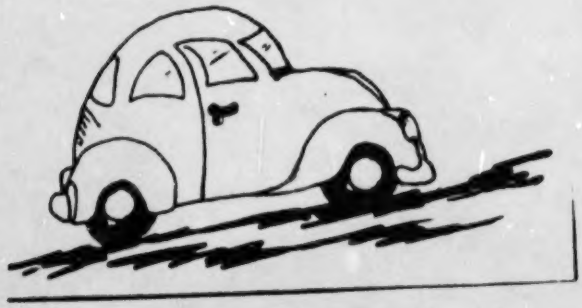


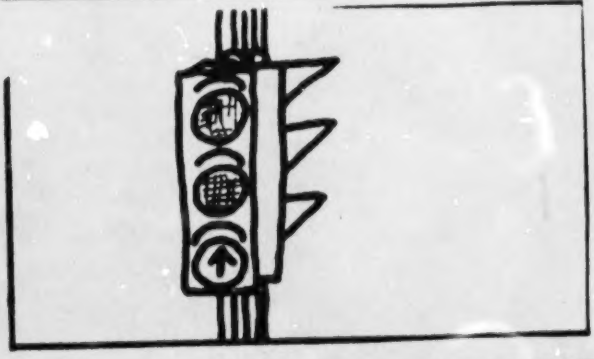
Wash
Wear

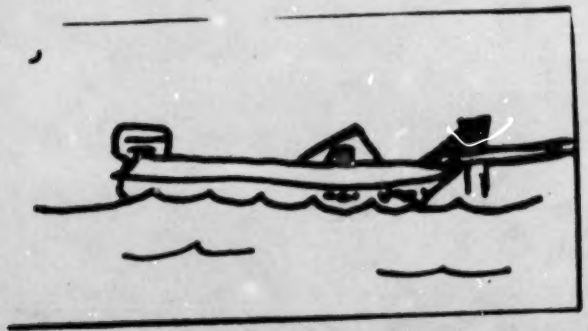


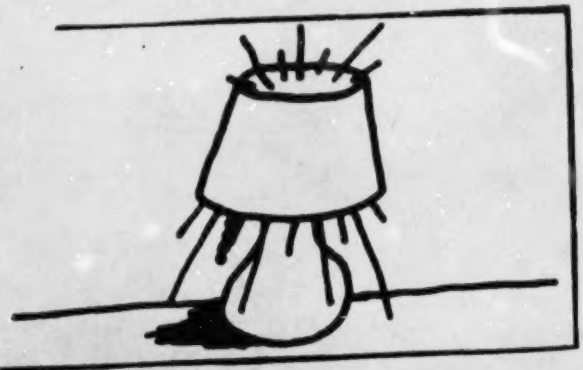
Machine Washable

NEWS
ENERGY
COSTS RISE









Answer Cards

WHERE IS THE WINDIEST SPOT?

43

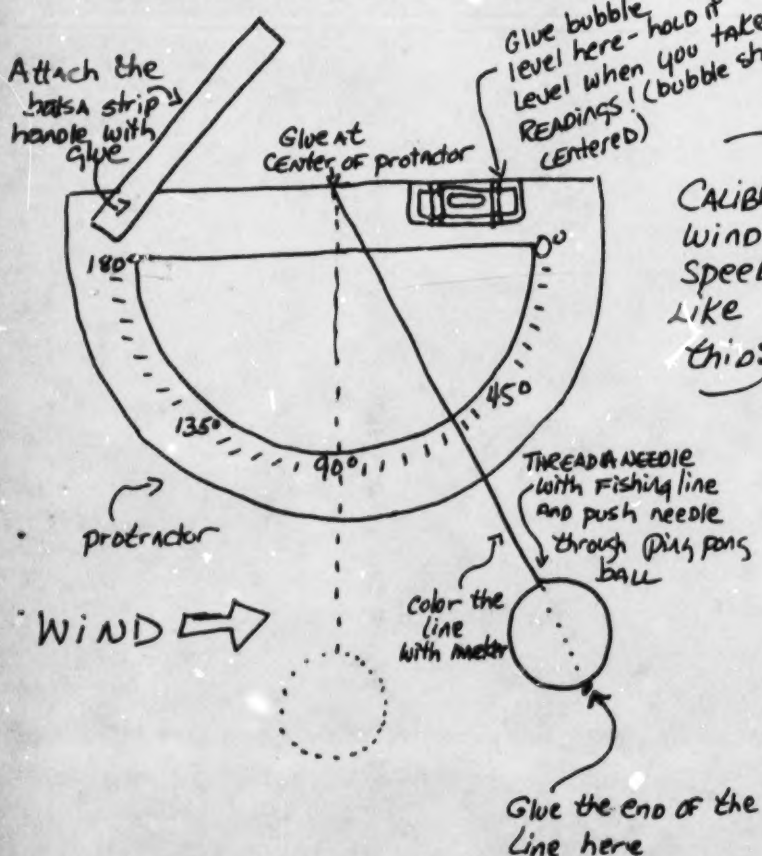
ACTIVITY:

Discuss with the class how wind is created, and the different ways wind power can be used. (pumping water, generating electricity, etc.) What are the advantages and disadvantages of wind power?

Have the students make a map of the school. Using the device pictured below, take wind measurements and designate the areas on the map where these measurements were taken. As an option, you may wish to take measurements twice a month to see if students can discover if wind currents are seasonal.

Keep a chart of the various wind speeds tested at different locations of the school grounds and the time of day they were recorded.

Have students discover if the wind speeds increase at higher elevations, places between buildings, and valleys or on hills.


Attach the balsa strip handle with glue
Glue bubble level here - hold it level when you take READINGS! (bubble should be centered)
Glue at center of protractor
180°
0°
135°
45°
90°
protractor
WIND
THREAD A NEEDLE with fishing line and push needle through ping pong ball
Color the line with marker
Glue the end of the line here

CALIBRATE WIND SPEED LIKE THIS:

angle	mph*
90	0
85	5.8
80	8.2
75	10.1
70	11.8
65	13.4
60	14.9
55	16.4
50	18.0
45	19.6
40	21.4
35	23.4
30	25.8
25	28.7

* miles per hour

CONCEPT:
To calibrate wind speed and determine locations that are best to utilize for wind energy.

SUBJECT:
Science

MATERIALS:
Per student:

1 ping pong ball
data sheet
1 piece of fishline
protractor
red magic marker
1 strip balsa, ½ cm. sq. x 18 cm long
1 bubble level
glue
needle

COOLING THROUGH EVAPORATION

44

ACTIVITY:

1) Set out three flat pans on newspaper. Add two cups of warm water to each pan. Place a thermometer in each pan. (Make sure the water covers the thermometers)

2) In the first pan add a few drops of oil. In the second pan let the fan blow across it. Leave the third pan without adding anything except the water and thermometer.

3) Make a chart like the one below and have the students fill it out at two minute intervals.

	Temperature				
	2 mins	4 mins	6 mins	8 mins	10 mins
Pan 1					
Pan 2					
Pan 3					

4) Which is the coolest? What is the purpose of the oil? How much liquid is left in each pan?

CONCEPT:

Evaporation is a cooling process.

SUBJECT:

Science

MATERIALS:

3 flat pans electric fan
newspapers
edible oil
warm water (40-50)
3 thermometers

AT WHAT TIME OF DAY IS THERE ENOUGH WIND TO MAKE ELECTRICITY?

45

ACTIVITY:

Enlarge or dupilicate the chart below of the Beaufort Wind Scale. Keep a record of the wind speeds at different times of the day at home or at school. At what time of the day do the fastest winds usually occur?

Decide if there is enough wind at your schools location to generate electricity. Any wind over 8 mph can be used to generate electricity. How many hours during the the day could a wind generator make electricity?

Are the winds in your area steady or gusty? Predict the winds from the clouds or other signs. How accurate is the weather bureau in your area in predicting the winds? What type of clouds are associated with different types of clouds?

BEAUFORT NUMBER	DESCRIPTION (mph=miles per hour)	OBSERVATION
0	calm (0-1 mph)	smoke rises vertically
1	light air (2-3 mph)	smoke drifts slowly
2	slight breeze (4-7 mph)	leaves rustle; windvane moves
3	gentle breeze (8-12 mph)	twigs move: flags extended
4	moderate breeze (13-18 mph)	branches move; dust & paper rise
5	Fresh breeze (19-24 mph)	small trees sway
6	Steong breeze (25-31 mph)	large branches sway: wires whistle
7	moderate gale (32-38 mph)	trees in motion; walking difficult
8	Fresh gale (39-46 mph)	twigs break off trees
9	steong gale (47-54 mph)	branches break; roofs damaged
10	whole gale (55-63 mph)	trees snap; damage evident
11	storm (64-72 mph)	widespread damage
12	hurricane (73-82 mph)	extreme damage KABOOM!

106

CONCEPT:
Wind speeds differ in various and can be utilized to harness energy.

SUBJECT:
Science

MATERIALS:
Copy of the Beaufort Wind Scale.

DISCOVER THE WIND

46

ACTIVITY:

Have students blow up a balloon and tie it off. They should then place the balloon in front of themselves and try to move it be creating wind. Discuss ways that wind moved the balloon.

Make a pinwheen using the pattern provided. Cut along all solid lines. Put a pin through each black dot and then through a straw or pencil eraser. Make sure thet paper can spin freely. Experiment with the amounts of wind required to make the pinwheen turn. How can you make the wind?

Place a drop of ink on the drawing paper. Allow students to blow the ink in one direction using a straw to create a tree like pattern. Use the sponge pieces to blot "leaves" onto the tree.

Discuss what caused the wind to move. Do trees grow because of wind energy? What kinds of energy do trees use? Produce?

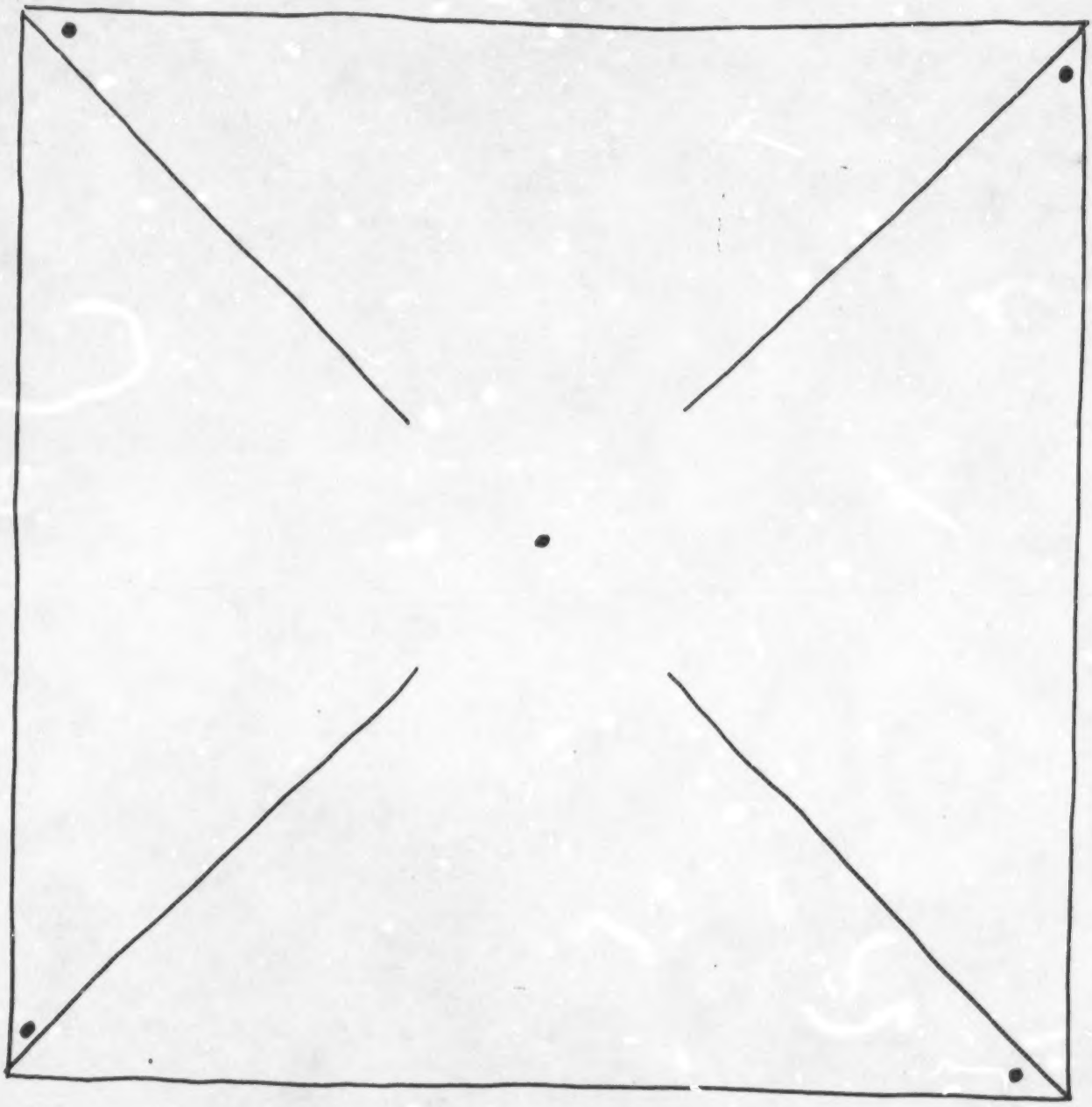
CONCEPT:
The wind is a source of energy.

SUBJECT:

Art
Science

MATERIALS:
Per student:

Balloon
Pinwheel pattern
Straw
Straight pin
Drawing paper
India Ink
Sponge Pieces



Pinwheel Pattern

108

WATER POWER

47

ACTIVITY:

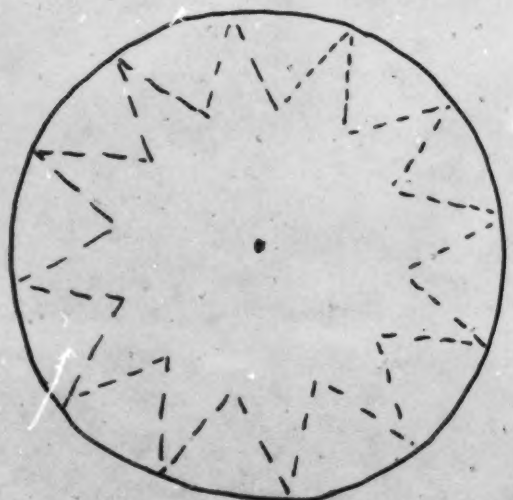
Have students bring-in pictures of a mill with a waterwheel. or use the accompanying picture. Ask the students what makes this wheel turn. Explain that the farmers use to bring their corn and grain to the miller who would grind them up in his mill. His mill was always built near a river so he could use moving water to turn the grinding wheels. Using the diagram below have the class make a water wheel.

Look at or have the students bring a picture of a hydroelectric power plant. Show the picture of the plant and dam provided. Ask the following questions:
What is moving in the picture?
Where is the water going?
Who has seen a waterfall? What did it look like?
Explain that a dam is a man-made waterfall that is built to use water as a source of energy. There is usually a large building next to the dam where electricity is produced from the moving water.

Taken from: The Energy We Use, Oak Ridge Association of Universities, U.S.DOE.

Instructions for constructing waterwheel:
Trace a waterwheel like the one below on a piece of tagboard. Cut alone the solid lines and fold in the dashed lines, making sure to fold in the same direction around the wheel.

Put a pin through the dot. Holding the pin, put the waterwheel under a slow-running faucet and watch the water make the wheel turn.



109

CONCEPT:

Water is a source of energy.

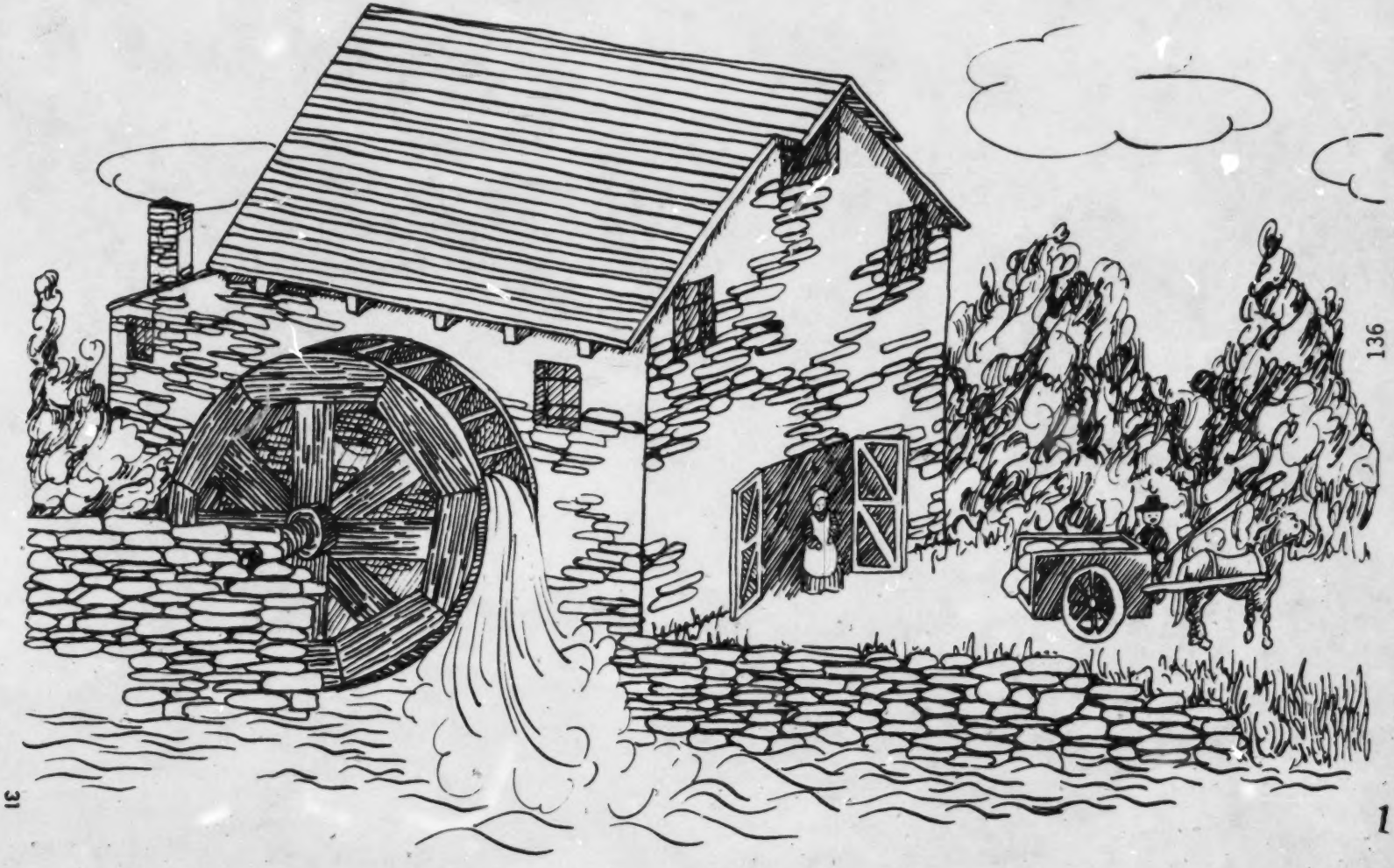
SUBJECT:

Science
Social Studies

MATERIALS:

Tagboard
Pins
Scissors
Pictures of waterwheel and dam

Taken from: The Energy We Use, Oak Ridge Association of Universities, U.S.Dept. of Energy



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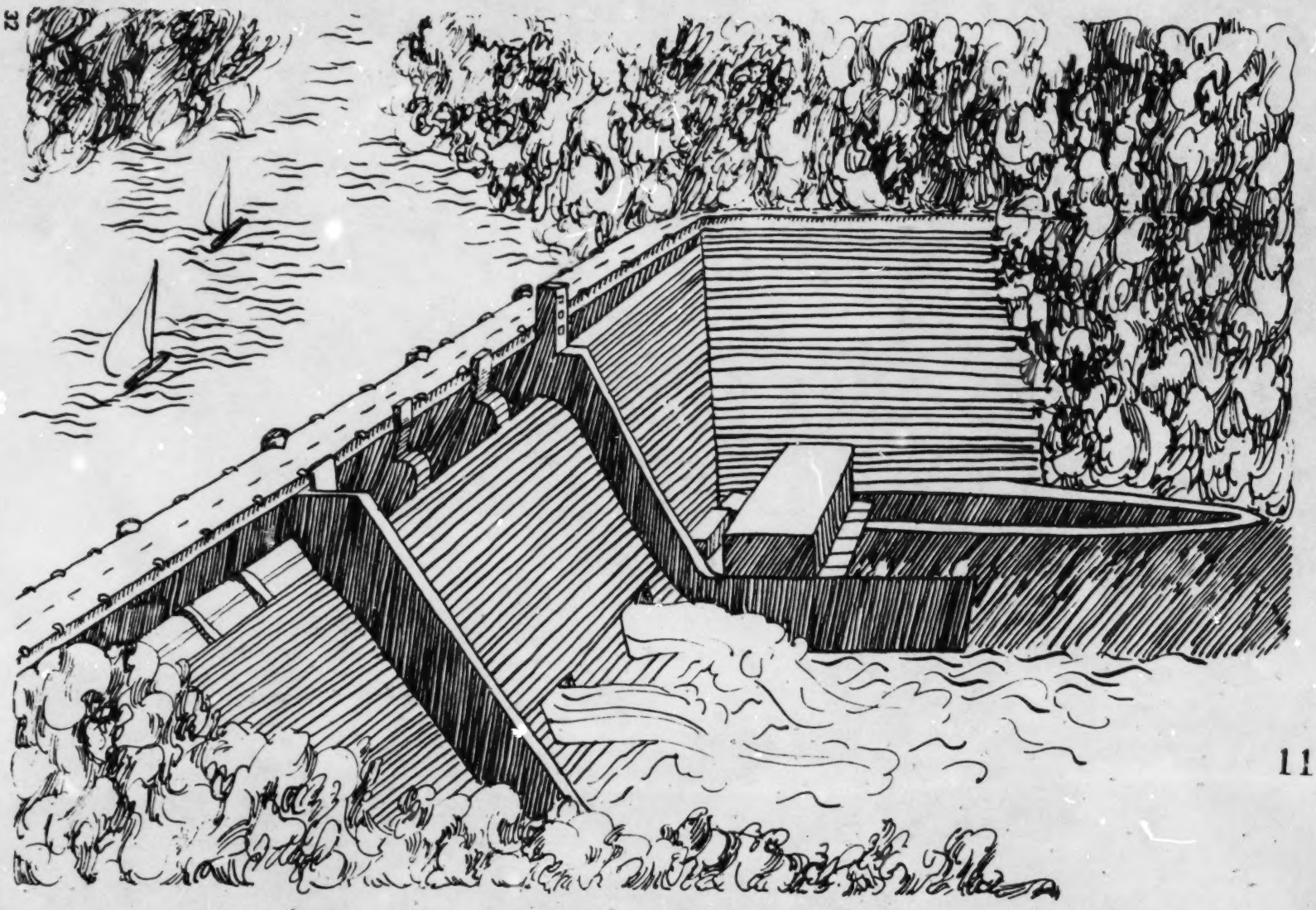
110

111



112

113

Taken from:The Energy We Use, Oak Ridge Association of Univeristies, U.S.Dept. of Energy

WHICH SOIL IS BEST?

48

ACTIVITY:

Have students fill eight cups with the following potting mixes:

Cup 1 and 2 - washed sand
Cup 3 and 4 - ½ sand , ½ soil
Cup 5 and 6 - soil and fertilizer
Cup 7 and 8 - soil and compost

Plant beet or radish seed in each cup and place them on a sunny window sill. Add teaspoons of water to each cup daily.

Record results on a graph.

Which sprouted the quickest?

Which grew the fastest?

CONCEPT:
Biomass is part of energy flow in natural systems.

SUBJECT:

Science

MATERIALS:
Beet or radish seeds
Sand
Soil
Compost
Fertilizer
8 Cups

BIOMASS

49

ACTIVITY:

1) Involve two or three children in a project to determine the gain in weight (mass that occurs when a plant is grown from a seed.

2) Weigh carefully the amount of dry potting soil necessary to fill a flower pot. Moisten the soil and plant a small seed such as a lima bean or pea which has been weighed carefully on an analytic balance by a high school science student or teacher. Record the weight.

3) Place the flower pot on a window ledge in the classroom where it will receive available sunlight, water as needed, and permit to grow for several weeks.

4) Remove the plant and as many roots of the plant as possible from the soil being careful to save the soil since all soil used in the project should be dried and reweighed to ascertain the loss, if any, from the original starting material.

5) Dry the plant and roots thoroughly and weigh. How does weight of the plant grown compare to the weight of the original seed? How does the weight of the plant compare with the change weight in the soil? Where did the gain in weight come from?

6) How important was sunlight in this experiment? Could the dried plant be burned to produce energy? Where did that energy come from?

CONCEPT:

Biomass is part of the energy flow in natural systems.

SUBJECT:

Science

MATERIALS:

Potting soil
Flower pots
Lima bean and pea seeds
Analytic balance

PLANT POWER

50

ACTIVITY:

1) Place a geranium in a dark closet for two to three days the leaves will begin to turn white.

2) Make an iodine solution by adding 5ml iodine to 45ml water. Using this solution test a potato for starch by placing a few drops of the solution on the potato, which has been cut in half. If it turns blue it has starch in it. Now test the white leaves from the geranium by crushing a leaf in a small amount of water. What happens? Test some sugar. What happens to it?

3) Remove several leaves from the geranium. Cover parts the leaves with black paper strips and place them in the sun for two hours. How long does it take for the leaves to turn green? Now test the leaves for starch again. What happened to the leaf under the black paper? Test it for starch too.

4) Test different foods for starch. Do some plants have more starch than others? Where did the starch come from? Can you trace your dinner back to the sun?

CONCEPT:

In natural systems, energy is transferred.

SUBJECT:

Science

MATERIALS:

Tincture of iodine
Geranium plant
Potato
Sugar
Graduated cylinder
Black paper
Paper clips

THE LITTLE SOIL TILLER

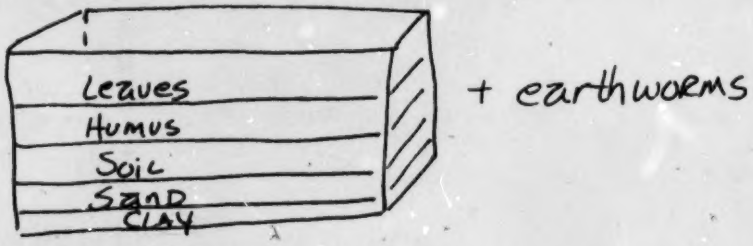
51

ACTIVITY:

The earthworm consumes its own weight in leaves and grass every 24 hours and is a humus factory returning otherwise unusable nutrients to the soil. Worm castings contain minerals. Worm tunnels open spaces for roots and water. Worms cannot hear or see but they are sensitive to light and vibrations. They eat dead leaves, twigs and insects and, in turn, are eaten by birds and burrowing animals.

Instructions for setting-up a worm farm:

Set-up two containers as shown below.



Collect worms and place them in only one of the containers. Keep the soil of this container slightly moist.

Have the students describe and draw pictures of the soils of both containers. Ask the students to predict what will happen to the soils.

Cover the worm container with a black cloth or paper. Allow air holes for breathing.

After 3 to 4 days, remove the paper and observe the worms and soil layers. Compare the soil in the two containers.

How is the worm like a tiller? How is it able to recycle materials in the environment?

Continue to observe and enjoy the activities of the worms. Place worms in the second container and watch them plow the soil.

Taken from: Energy, Food and You, Washington State Office of Public Instruction, 1977.

CONCEPT:
The earthworm is a link in the energy flow of natural system.

SUBJECT:
Science

MATERIALS:
2 Terrariums or glass containers
Earthworms
Clay, sand, soil, humus, and leaves

WOOD ENERGY

52

ACTIVITY:

Have students select a favorite item of theirs which is made of wood. After selected distribute drawing paper and pencils and have each student trace back each step it took to make their favorite item from a tree to the finished product.

How do the ways we use wood today compare with the way people used wood 200 hundred years ago?

Have students discuss the pros and cons of using wood today as a major heat source.

CONCEPT:
Wood is a source of heat energy.

SUBJECT:

Language arts
Social Studies

MATERIALS:

Paper
Pencils

118

SECTION III

ME AND MY HOMETOWN .....HOW DO I USE AND ABUSE ENERGY?

SECTION III: ME AND MY HOMETOWN . . .WHO DO I USE AND ABUSE MY ENERGY?

This last section focuses on ways in which we all waste energy in our communities. There are many suggested ways to remedy the waste. Special attention is given to the importance of the conserving and sharing of our limited resources for present and future generations.

MOBILE-IZE

53

ACTIVITY:

Give each pupil a coathanger. Allow them to decorate it in any way they would like. Colorful string or yarn may be wrapped around it. It may be covered with scraps or aluminum foil. Stripes may be applied with masking tape. Be imaginative!

By tying yarn or string of differing lengths to the lower edge of the hanger, attach articles that center around energy themes. Assign a theme to the students or let them choose their own. Examples might include:
a)things that are thrown away at school
b)things that can be recycled
c)things that are made from petroleum
d)things that use energy
e)sources of energy
f)unnecessary containers
g)things that use the sun's energy
h)ways we can save energy

Students may want to cut pictures form magazines, draw pictures from magazines, draw their own pictures or use items collected from a nature hike. The trash can is a great source of ideas.

Have the students talk about their mobiles when they are completed. Why was each article included? Can the other students guess the theme just by looking? Let them give their art object a title.

CONCEPT:

To review energy sources, ways to recycl and save energy

SUBJECT:

Science
Art
Social Studies

MATERIALS:

Per student:
Coathanger
Yarn or string
Odds and ends,scrap materials

IT'S ALL USED UP

54

ACTIVITY:

Give each student one cookie and tell them to eat it. When they finish their cookie, they should raise their hand and keep it up until everyone is finished.

Every 15 seconds, record the number of children with their hands raised. Record the length of time it took for all cookies to be eaten.

Discuss the idea that when the cookie is all gone, there is no more - it is all used up. Talk about some energy sources that can be used up - such as coal and oil. One way to conserve or save these limited resources is to ration them.

Pass-out the other cookies to each child and tell them that they can only take a bite every 15 seconds. Again, they should raise their hands when they have finished their cookie. Record results as before.

Compare the imtes from the first and second cookies. Could we make our limited resources last longer?

CONCEPT:
There are some energy sources in limited supply.

SUBJECT:

Science
Math
Social studies

MATERIALS:

2 cookies per student
1 stopwatch

FUELISH - THE "OLD MAID"

55

ACTIVITY:

Teacher preparation:

Make a single copy of the Fuelish card and 2 copies of each of the other energy user cards. These could be run on paper and mounted on cardboard or railroad board.

Game Directions: (to be played by 2 - 4 players in the same manner as Old Maid)

Deal out all cards.

The player to the left of the dealer draws one card from the player on his/her left. If the person playing can match a pair of cards, the pair is to be laid down.

Then the person to his/her left draws in the same manner and play goes on until someone is out of cards.

Scoring is as follows:
+ 1 point fpr eacj card down when someone goes out.
- 1 point for each card still held.
+ 3 points for going out first.
- 5 points if you hold the FUELISH card.

CONCEPT:

To identify various items which use energy

SUBJECT:

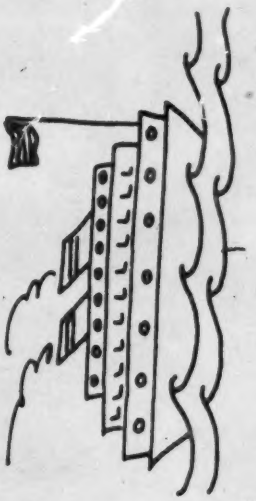
Social Studies
Science

MATERIALS:

2 Copies of all the energy user cards.
1 Copy only of the Fuelish card.

Energy User Cards

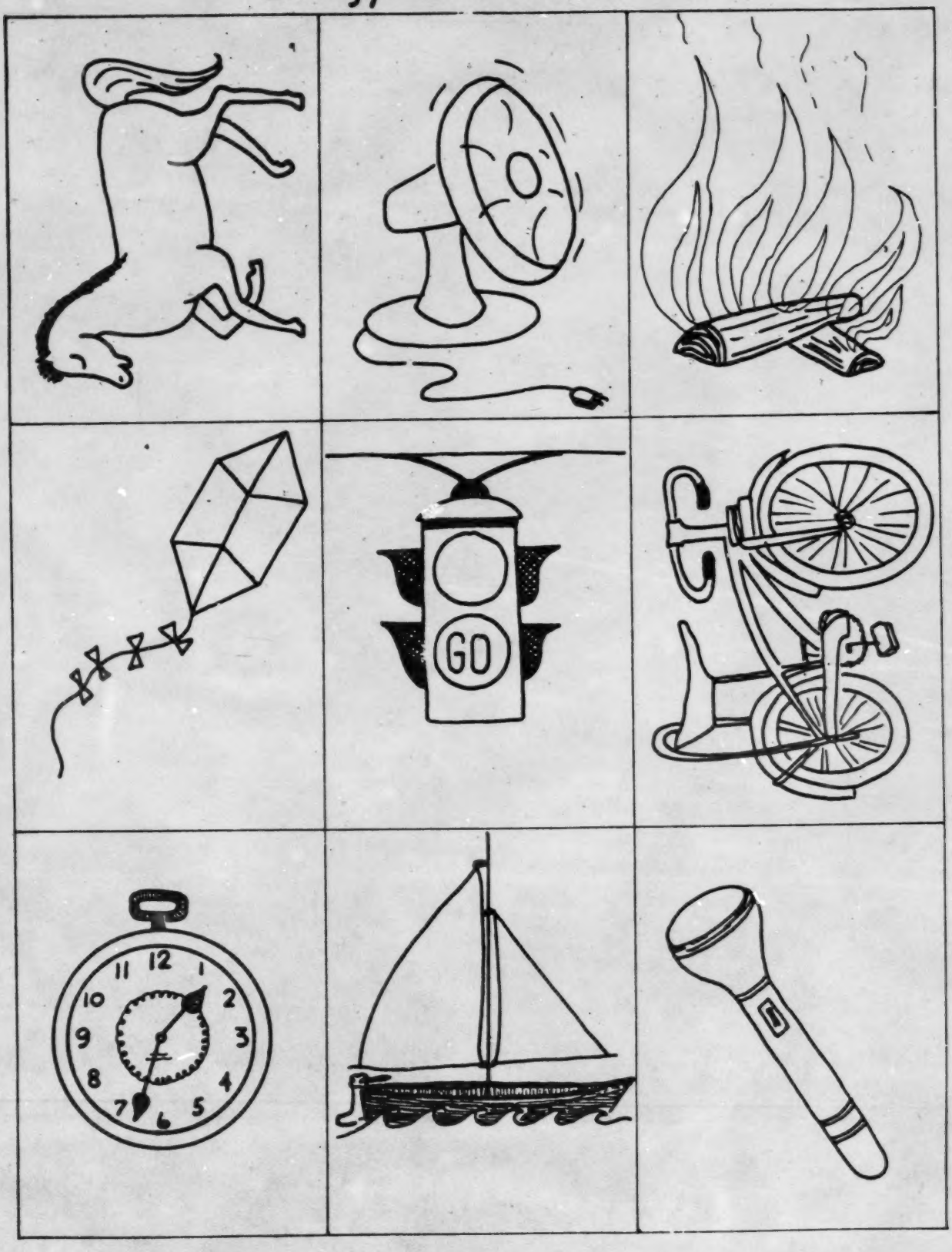
leaf



gas stove

diesel bus

Energy User Cards



TAKE A LOOK AT YOUR BEDROOM!

56

ACTIVITY:

Using the picture handout provided have each student color, mark or list each energy product they can find in the room.

Have the student survey their own bedroom. Have them list all the energy products found in their bedroom.

Ask students to survey their homes and find how many different ways they use energy in other rooms of their house. Have them talk with their parents and/or brothers and sisters about how the energy products are used. Have them bring their ideas back to class and add these products on a "home energy" list.

CONCEPT:

To be aware of the uses of energy products in the household.

SUBJECT:

Social Studies
Science

MATERIALS:

Picture handout per student
Crayons, pencils

1-71

158

HOME ENERGY PRODUCTS

57

ACTIVITY:

Put the words "Home Energy Products" on the board. List the students' responses. Discuss the following:
What energy products do you use in your home?

What energy products fo you use every day?

Which products are most necessary?
Which products are least necessary?

Collect as many pictures of home energy products. Have the students place in order those products they use the most to those products they use the least.

The students could now list althernate ways to accomplish tasks without the use of various appliances. (ex., Electric toothbrush can be replaced by hand toothbrush, blender could be replaced by muscle)

Make a survey of the class pictures to see which product is used by most people in the class. Which is the least used by the class? A graph is a good tool for this survey.

CONCEPT:

To list ways we are dependent on energy using gadgets and seek alternate methods that would conserve energy.

SUBJECT:

Social studies

MATERIALS:

Pictures from catalogs
Glue
Scissors
Graph paper

WAYS TO WE USE AND SAVE ENERGY

58

ACTIVITY:

Display on chalkboard of chart headlines from newspaper or magazines relating to energy problems. Use these clippings as motivation for a discussion starting with questions such as: "What is energy? Why do we need energy? What makes energy? What makes the lights get bright? What made your clothing? etc." Let the classroom discuss. Then give the statement: "Energy is measured in calories, kilowatt hours and other units. Energy is the capacity for doing work."

Write the follwoing list of electri appliances on the chalkboard. Have students copy the words and write at least one advantage and one disadvantage for each:

toothbrush	airconditioning
toaster	radio
freezer	television
hot water heater	range
lights	dishwasher
heating system	

While the students are doing the preceding activity, copy the follwoing list on another part of the board. Given in the table below are the relative amounts of energy used in operating various devices for one hour. The unit is the approximate amount of work a man could do in one hour (0.06 kilowatt hours). This list was taken from the Citizens' Workshops of the U. S. Atomic Energy Commission Handbook.

100 watt light bulb	2
Color TV	4
Manufacturing one pop bottle	10
Toaster	18
Air conditioner	50
Electric dryer	70
Oven - baking turkey	75
Small lawn mower	160
Gas log fireplace	300
Motor bike	500
Small car - 45 mph	1,000
Large car - 70 mph	4,500

Students share their list of advantages and disadvantages. Read together the list of energy used in operating devices. Listen for comments. With this additional knowledge have the students go back to their list of advantages and disadvantages. Some students may want to make some changes. The conclusion should result in such comments as: "Don't let hot water just run. Turn off lights and TV when not in use, etc."

CONCEPT:
Some human technologies use more energy than others

SUBJECT:

Science
Home Economics
Social Studies

MATERIALS:

Newspaper and magazine clippings
Construction paper
Film or filmstrip on production
Pop bottle
Paper for making a diary
Paper for creating a story or book

58

ACTIVITY:

As homework have the students write down each time they see a light on, a tv on, a radio on, etc. that no one is using.

So far the class has just talked about how much energy something uses. At this point discuss how much energy it takes to make a radio, a tv, a light bulb, etc. Show a filmstrip or film on some type of production.

Refer to pop bottle stories. Have some studnets share their stories with the class.The class may want to make individual books of their stories for others to read.

Discuss: Now the pop bottle is empty. Where does the bottle go? To the garbage? If is goes to the garbage or is broken what will have to happen to replace the bottle? What can be done with the bottle? What can we do with bottles that cannot be returned for deposit?

Students are to make a collage using magazines, newspaper, and art paper. The theme of the collage:"Let's Save Energy"

Have students make a small diary recording events for the following month. Students are to record how they saved energy each morning as class begins. Comments from the teacher regarding students' behavior will increase their awareness and reinforce their changes in behavior.

CONCEPT:

SUBJECT:

MATERIALS:

READING THE METER

59

ACTIVITY:

Give each child Meter Worksheet #1. Discuss how an electric meter is read. Practice using the sample and other examples. Meters are read in kilowatt-one thousand watts - hours.

Give each child Meter Worksheet #2 to take home and read their meter. Read the meters again one week later.

Meanwhile, discuss some ways that energy - kilowatts - could be saved at home. Have the students try some of these for another week and read the meters again.

Compare the readings. Were any kilowatts saved?

Older shildren will be able to discuss the source of the electricity used in their homes. If they save kilowatts at home, what energy source are they conserving?

Invite a local utility representative to visit your class and show an electric meter.

CONCEPT:

To be able to read a meter and compare readings of the meter as a checklist for saving energy.

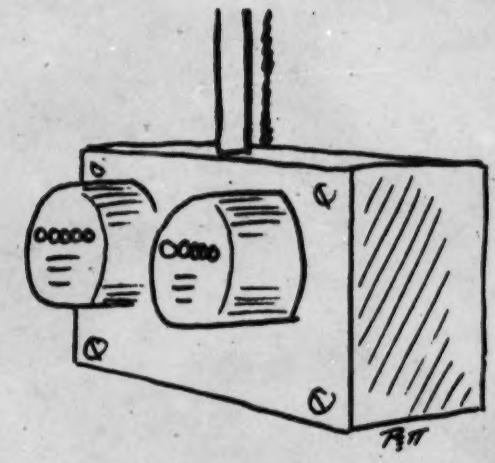
SUBJECT:

Science
Home Economics
Math

MATERIALS:

Meter Worksheet #1 and #2

METER WORKSHEET #1



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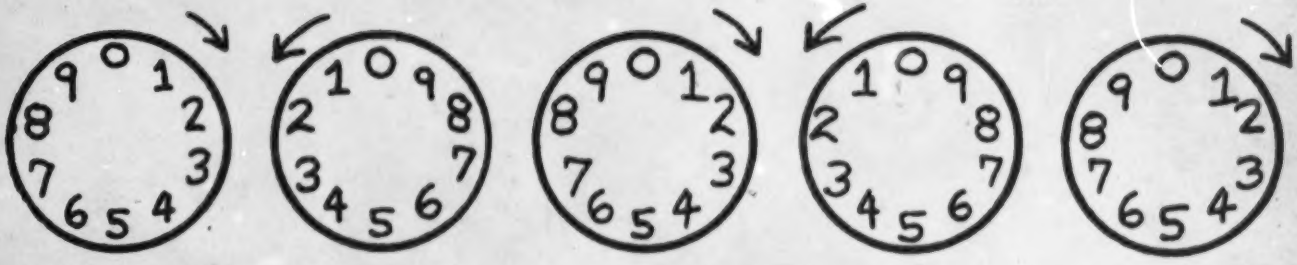
METER WORKSHEET # 2



NAME: _____

THERMOSTATS GOING DOWN

60

ACTIVITY:

Make a classroom chart that will show the temperatures in your own classroom during the morning and the afternoon. Keep a record of the temperatures for one week. What are some reasons that the temperatures are different in the morning than they are in the afternoon?

Have the custodian lower the thermostat in your classroom by 1 or 2 degrees. Make another chart and keep a record of the temperature in your classroom for another week with the lowered thermostat. Compare the 2 charts. Do you notice any differences in the temperatures? During which week were the temperatures the lowest in your room?

Now take a tour of your building and check the thermostats in the other rooms. Do you think they could be lowered a couple of degrees? How would this help your building save energy? Could you do this at home? Who would this help your parents?

CONCEPT:
Individual action can help to extend the available energy resources.

SUBJECT:
Social studies
Science

MATERIALS:
Thermometers
2 Charts

NEEDS VERSUS WANTS

61

ACTIVITY:

Have students list 12 of their favorite items in their homes that require electricity to operate. Discuss the following statements and questions with the class.

If there were a decree which said you had to use less electricity, draw a pencil line through the three items you could really do without.

Circle in pencil the three that really mean the most to you and that you would hold on to until the very end.

Now look back over your list and your decisions and consider:

Why did you decide to do without the three items?
Why did you want to keep the other three?
Using information provided on the next sheet, determine how many kilowatt hours and how much money you will need, based on Question 2.

Again based on Question 2, list the efficiency steps you can take to reduce the kilowatt hours and money consumed by each of the three appliances.

CONCEPT:
Students will analyze various ways they use energy.

SUBJECT:

Science
Math

MATERIALS:
per student:
Annual/Monthly Electric Energy Use and Cost Sheet

ANNUAL/MONTHLY ELECTRIC ENERGY USE AND COST SHEET

Taken from: Tennessee Valley Authority Utilization Division

Electricity is measured and you are billed by the kilowatthour (kWh). A kWh os equivalent ot the electricity used by ten 100-watt light bulbs burning for one hour. To get the approximate operating cost for the appliances listed below, contact your power distributor for your cost per kWh. Then multiply the estimated monthly (or seasonal) kWh by the electric rate.

	Average kWh(Annually)	kWh(Estimated Monthly)
Electric furnace	13,200* (seasonal)	. . . . .
Heat Pump	6,600**(seasonal)	. . . . .
Quick-recovery water heater	4,200	350
Clothes washer	1,900***	158
Refrigerator/freezer (14 cu. ft. frostless)	1,800	150
Freezer (15 cu. ft. frostless)	1,800	150
Dishwasher	1,560***	130
Air conditioning (Central, per ton)	1,500 (seasonal)	
Freezer (Manual, defrost)	1,200	100
Refrigerator (manual, defrost)	1,200	100
Range	1,200	100
Clothes dryer	1,000	83
Color television		
(Tube type)	660	55
(Solid state)	440	37
Dehumidifier	400	33
Black &White television		
Tube type	350	29
Solid state	120	10
Attic fan	300 (seasonal)	
Microwave oven	300	25
Roaster	200	17
Frying pan	190	16
Electric blanket	150 (seasonal)	
Hand iron	150	13
Radio-phonograph	110	9
Coffeemaker	110	9
Trash compactor	50	4
Vacuum cleaner	50	4
Toaster	40	3
Food Disposer	30	3
Sun lamp	20	2
Clock	18	2
Mixer	10	1
Toothbrush	0.5	0.04

*Based on 1,500 Sq. Ft. fully insulated housed located in a 3,500 degree day area

** Heat only

***Includes kWh for heating water used in these appliances.

DRAFT-EATING DRAGONS

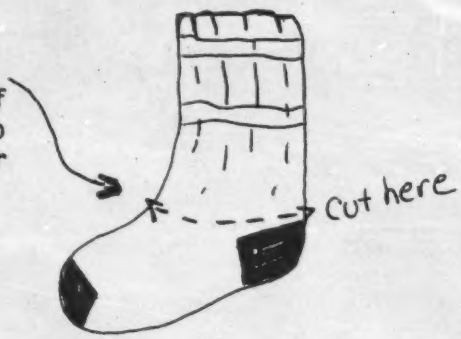
62

ACTIVITY:

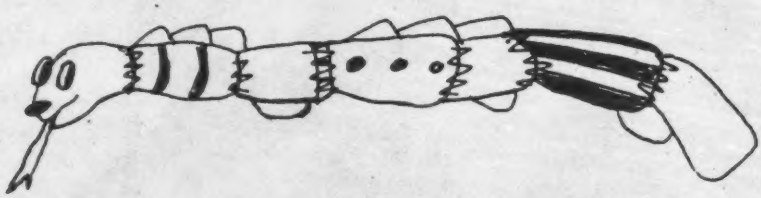
Now that students have located drafts from the preceding activity ask them to bring -in odd socks from home to be recycled into "draft-eating" dragons.

For each dragon you will need 7 or 8 socks. Save 2 toe sections for the head and tail of each dragon.

Cut socks above the heel. (Save this portion to stuff dragon. You may also wish to have extra rags on hand for stuffing)



Darn the middle sections together and decorate by gluing or sewing on felt, shapes for eyes, humps, etc.
Draft dragons "sleep" at the base of doors on cold winter nights. Keeping the family safe from wasteful drafts.



Discuss other ways to stop drafts.
Bring materials used to insulate (foams, tapes, etc.) to show students.
Finally hold up a jar containing the "mystery insulator".
What is this mystery substance? . . . .AIR
Ask students how we use air to insulate. Examples include storm windows, doors, etc.
How do animals insulate?
Which use air? (Go outside and observe how birds fluff themselve up.

CONCEPT:
To demonstrate ways to conserve energy around the home and school.

SUBJECT:

Science
Art

MATERIALS:
Per dragon:
7 or 8 Socks
Rags for stuffing
Thread and Needles
Felt, sequins, scraps of materials
Glue
Scissors
Darning needle and yarn

IS YOUR HOUSE DRAFTY

63

ACTIVITY:

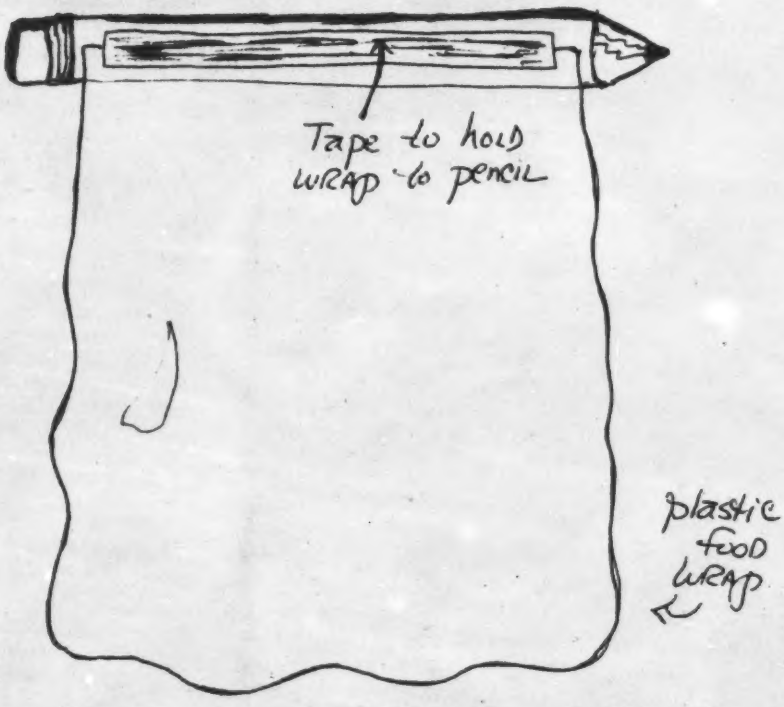
Have students make a draft meter following these instructions:

Cut a 12cm by 25 cm strip of plastic food wrap.

Tape the wrap to the pencil.

Blow the plastic gently and see how freely it reponses to air movement.

Test your home and school for air leaks by holding the gadgets near the edges of windows and doors



CONCEPT:
To demonstrate ways to save energy around home and school

SUBJECT:
Science

MATERIALS:
Per student:
Pencil
Scotch tape
Plastic food wrap

INSULATING AN ICE CUBE

64

ACTIVITY:

Organize teams of 2-3 students.

Tell students that you have collected some materials together for an interesting game. Each team will receive 1 ice cube. The goal of the game is to prevent the ice cube from melting for the longest time possible - they must keep it cool. Show the materials you can use to wrap the ice cube.

Give each group an ice cube in a plastic bag taped shut.

In order to keep track, place 1 cube in a plastic bag and suspend it by string. This ice cube will be used as a timer: when it is almost completely melted the game will end.

At conclusion, have students obtain the ice cube bags from their environments and compare the results.

Have the students identify the material which preserved the ice cube the longest. Did the thickness of the material make any difference? Ask them to think about the materials they would use if they played the game again.

CONCEPT:
Insulating materials help to maintain cold or warm environments.

SUBJECT:

Science

MATERIALS:

Per class:
Ice cubes,
Plastic bags,
Insulating materials such as paper(varying thicknesses),cardboard, styrofoam cups, aluminum,foil, glass cups,metal cups, metal cups,plastic containers,wax paper, newspaper,foam rubber, vermiculite,sand, small wooden containers different cloth materia cotton balls.

CASH FOR TRASH

65

ACTIVITY:

Make copies of "A Very Short History of Trash" and psass them out to the class. Discuss the major points. Point out current obstacles to recycling. Note the recyclable material that currently is not being recycled in your area because of economics: compare to the hidden costs of waster: pollution, finding a place to bury or dump it, careless use of limited resources.

Have students look for the kinds of waste material they dispose of at home. Discuss the students' findings. What is the most common area of waste? What items that can be recycled aren't? Do we often have a choice between a recycled container and a throw-away? What one material would the students choose to recycle that is not being recycled now?

Discuss industrial wastes in your community or area, such as byproducts from manufacturing, wood ends from lumber mills, manure from stockyards, steam loss from a factory. Ask the students if they can think of a use for the waste or a by-product. Examples may include composting and bioconversion.

Class Activity:

Field Trip to a Recycling Center:
Collect all the recyclable material and sort if properly (following instruction from the center). Visit the center with the students, having arranged in advance a time when a knowledgable person can discuss the economics of recycling.

Field Trip to the City Dump:
The dump is an ideal spot to demonstrate needless waste. Have the students interview the person in charge. What items are most likely to find their way to the dump? Have they usually been fully used? Have students think of another use for one item they see at the dump. Bive a prize for the most creative, workable idea.

Taken from: Connections, A Curriculum in Appropiate Technology, National Center for Appropiate Technology.

CONCEPT:

To explore the possibilities in the community which would help recycle materials.

SUBJECT:

Science
Social Studies

MATERIALS:

Per student:
A copy of "A Very Short History of Trash"

A VERY SHORT HISTORY OF TRASH

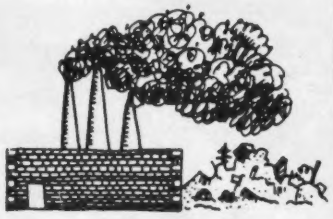
1 People have always had trash. Only Cavedwellers didn't have a big problem with it. In those days, there was plenty of room for trash. And nature easily disposed of it.

2 Today, trash is a big problem. More people mean more trash and more different kinds of trash. You name it — cans, paper, bottles, garbage, old cars, old clothes. In time it becomes T-R-A-S-H.

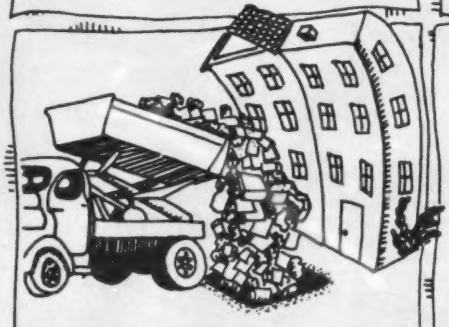
3 Every year, each one of us throws away almost ONE TON of trash. If you piled this trash in your living room, it would come to your shoulders.

4 In one year, all our trash amounts to 360,000,000 tons. We have problems with trash that Cavedwellers never had. To get rid of it, we have tried to...

5 ...burn it. But burning trash can cause air pollution.



6 ...dump it in the ocean. But dumping can pollute the ocean, too.



7 ...bury it. But we're running out of empty land near cities.

8 Some scientists have even suggested shooting it off into empty space. But who wants old tennis shoes and pop cans orbiting the earth?

9 In the past few years, however, we have found a new way to get rid of some of our trash. It's called RECYCLING.

Recycling means reusing our trash instead of getting rid of it. This solves the problem of what to do with our trash and it also helps us with another problem. By using the same materials over and over again, we save our natural resources.

Recycling means shredding old cans and cars and melting the pices to make new metal for new cans and cars...

...chopping up grass cuttings and garbage to burn for energy or to make fertilizer to help new plants grow...

...crushing bottles into tiny glass bits and melting these bits to make new glass.

* *Concept provided by McDonald's Corp.*

DON'T THROW YOUR TREES AWAY

66

ACTIVITY:

The material on the following pages was taken directly from CONNECTIONS: National Center for Appropiate Technology. Discuss with your students the importance of recycling activities and the less stress placed upon our natural resources as a result. These activities may be adapted for a learning center.

CONCEPT:
Impact may be less on our natural resource when we recycle.

SUBJECT:

Social Studies
Science
Art

MATERIALS:
Handouts per student on the following 3 pages
Materials as described in the paper making activity

Each ton of paper that is recycled replaces and preserves an acre of harvestable trees.

The recycling of paper reduces waste and garbage pollution.

Recycling old paper uses 50 percent less energy than making new paper from trees.

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Recycling: Our Heritage in Papermaking

Today there is much discussion about recycling. In the seventies, recycled paper is an attractive alternative to wood fiber in making paper. Actually, the process of recycling is not new to the manufacture of paper in the United States. During the early colonial days paper was made from old clothing!

Paper is often referred to as the "handmaiden of civilization." It is vitally important in the field of knowledge as a keeper of records and as a medium for communication. The degree of civilization of a country may be measured by the amount of paper consumed. It is hard to imagine being without paper. The tools of the financial industry rely on paper. Consider not having paper money as a means of exchange. Also, industry and government would be unable to operate without paper.

History of Paper

Invented by the Chinese in 105 AD, paper gets its name from papyrus, a reed that the early Egyptians used for making writing material. Papyrus stalks were cut into thin slices and pressed into sheets. The Chinese later found that paper could be made by pounding rags, hemp, old fish nets and the inner bark of the mulberry tree into a fibrous pulp. These fibers were then matted into sheets and dried.

The Chinese art of papermaking spread to other parts of the world through the Middle East. Europeans started manufacturing paper in the 12th and 13th centuries. At the end of the 16th century, England was manufacturing paper in large quantities and supplying the needs of the American colonies.

By 1690, the increasing demand for paper in America led to an establishment of a paper mill in Philadelphia to produce writing paper. The primary raw material was discarded clothing – old rags – which was recycled to manufacture paper.

During the 19th century, several new developments changed paper manufacturing. Paper machines were invented to make paper in continuous rolls and wood fibre began to replace old rags as the primary source of material. With lower manufacturing costs, the demand for paper increased markedly. As a consequence of these events, recycling became less important to the paper industry.

Recycling Paper Today

Recycling today is again vitally important both from an economic and environmental standpoint. The rising costs of harvesting our forests, a growing accumulation of garbage and higher energy costs make paper recycling an attractive economic alternative. When you recycle waste paper, instead of throwing it away, you help conserve resources and protect the environment.

The first link in the paper recycling process is you – the individual who separates and saves waste paper. The collection of commercial quantities of waste paper is the second link. Fibres International, a modern waste paper processing facility located in Bellevue, Wash., is an example of this second process. Here, waste paper collected from businesses, from individuals delivering paper to the plant, or from groups conducting paper drives, is processed and supplied to recycling mills – the third link in the chain. Mills process the old paper into new and attractive paper products which come back to you – the first link in the chain. And so the cycle continues.

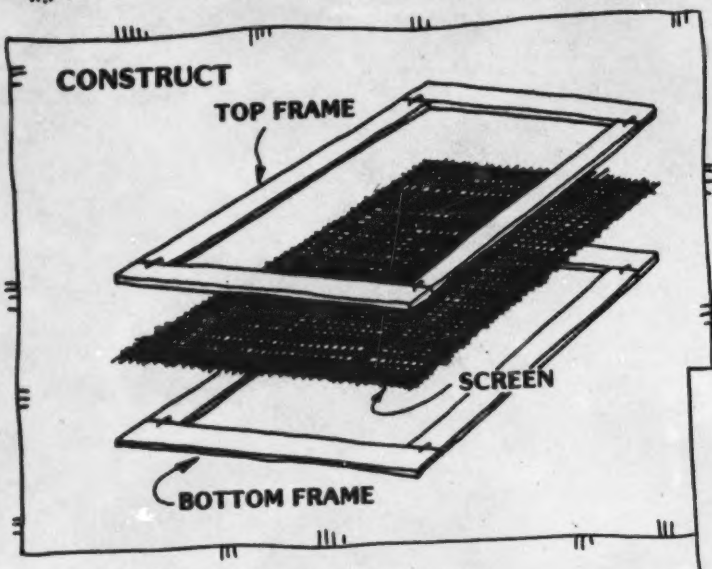
Some typical types of waste paper used in the recycling process include old newspapers, computer printouts, old corrugated containers, and tabulating cards.

Why Recycle Old Paper?

- Recycling old paper uses 50 percent less energy compared to making paper from trees.
- Each ton of paper that is recycled replaces and preserves an acre of harvestable trees.
- The recycling of paper reduces waste and garbage pollution.
- Recycled paper makes strong, attractive, and inexpensive packages.
- A recent survey indicated people prefer recycled packages because they help the ecology.
- Recycling helps school groups make money for travel purposes, purchasing new equipment, or donating to charitable causes.

* *From "Old News is Good News for Schools," Fibres International, 1533 120th Ave. N., Bellevue, Washington.*

HOW TO MAKE RECYCLED PAPER

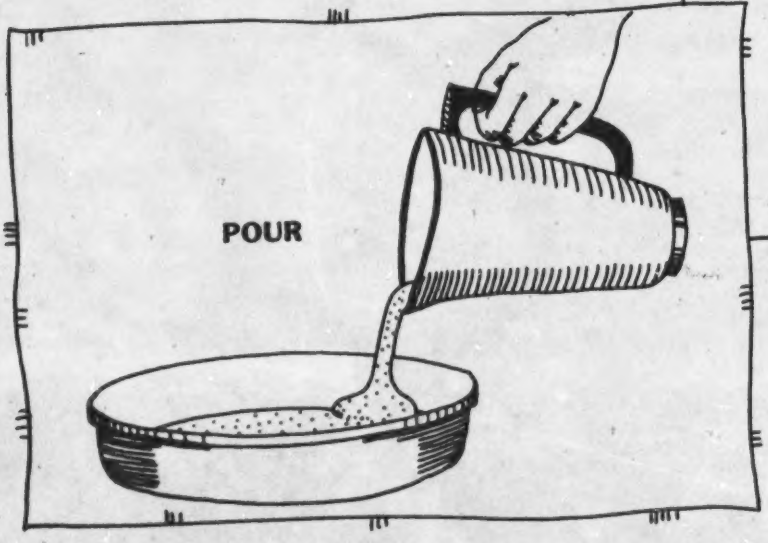


1 FIRST YOU NEED A FRAMED SCREEN, LIKE THIS:

Use thin pieces of wood to make the top and bottom frames.
Staple the screen to the bottom frame only.
Staple corners of wood frames together on top and on bottom.

2 THEN, YOU NEED THE PULP:

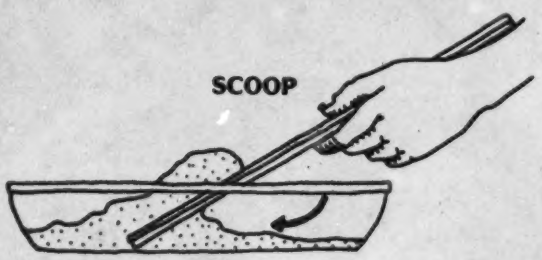
A quick way is to tear up some waste paper into tiny peices, put it in a blender and add a little water. About 1/2 page of newspaper will do. Add 1 T of cornstarch for strength.

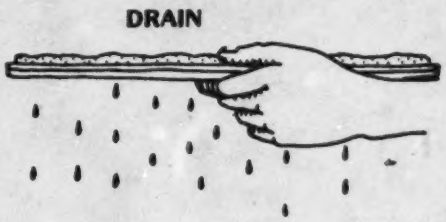


After this is thoroughly blended to a pulp, pour it into a tub or pan, large enough to dip the screen into.

Pulp should be like split pea soup.

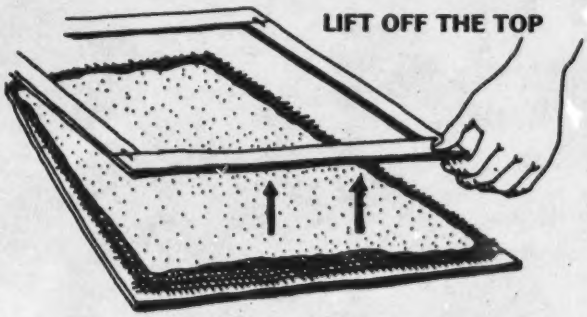
3 NOW COMES THE HARD PART:





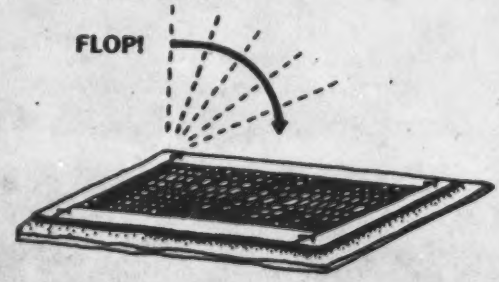
You have to scoop up the pulp out of the tub with the framed screen so that most of the water drains out. Make sure the pulp is on evenly.

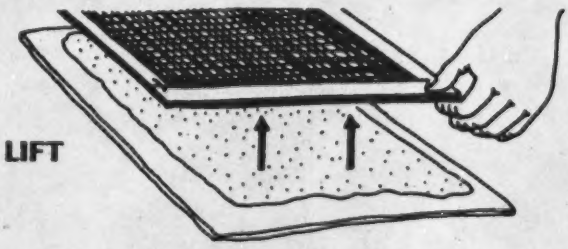
Next, tilt the frame up and wipe off the bottom of the screen to give it a smooth finish and to get out excess water.



Lift off the top frame, but be extra careful not to break the edges of the pulp.

Flop the bottom frame and screen over onto a white felt square and press down with another piece of felt to get out more water.





Now carefully lift the screen off. Take the paper over to newsprint and peel off the felt. Leave paper for 24 hours.

LET'S ALL DO IT TOGETHER

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ACTIVITY:

Have the students develop paper conservation activities. These may include:

*Write on both sides of paper for homework assignments.

*Use linen hand towels and cloth napkins instead of paper ones.

*Notify the post office to stop delivery of junk mail to your home or school. If enough people did this, perhaps a change would result.

*Keep a recycle box for the classroom for used paper. Use scraps for a collage, drawings, etc.

*Have students think of various ways to use newspaper such as:
-Rolling the paper into fireplace "logs"
-Using it for papier mache'
-Wrapping presents

For further activity:

Sprinkle garbage in the hall of the school. Teacher observes and lists who notices or picks up litter. Eventually discuss the problem of the litter in the hall and ask questions like these:

How does the litter in the hall make you feel?
What would it be like if no one cleaned it up and more was a-ded each day?
What rules would you make to keep the area clean?
How is our porblem of litter like the problem in communities?
What rules would you make ot keep the community clean?

Take you students on a short walk around the school yard and surrounding area near roads. Make a collection of different kinds of litter they see..Bring to cllassroom and make a display and then decide what to do with your collection. Explore alternatives and select best one by vote.

Have students act out the part of a piece of litter. Dress up like litter. Have litter coming out of actors' pockets, shoes, dress, shirt, hands, hair, etc. Presentations can be in the form of pantomime or charades.If dialogue is desired have students make up a script or do impromptu:
"If litter could talk, what would it say?"

CONCEPT:
Individual action can help to improve environmental condition:

SUBJECT:

Social Studies
Language Arts

MATERIALS:

GARBAGE PAIL COMPOST

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ACTIVITY:

Duplicate the following activity sheets for the students and do the suggested activities. These activity sheets are taken directly from: CONNECTIONS:A Curriculum in Appropiate Technology, National Center for Aporopiate Technology

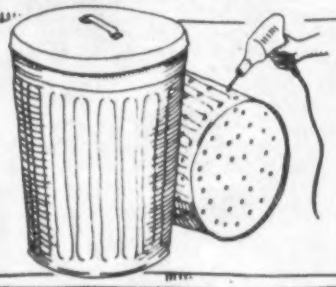
CONCEPT:
Composting litter material is a viable way to recycle material.

SUBJECT:

Language Arts
Home Economics
Social Studies

MATERIALS:
Per student:
Activity sheets on
"How to Make a Garbage Pail Compost"
"Organic Gardening"
"Tips for a Successful Garden

HOW TO MAKE GARBAGE PAIL COMPOST



1 DRILL HOLES IN THE PAIL

Use an electric drill that holds a 3/8" drill bit and make 30 or 40 holes through the bottom and lower sides of the pail as shown.

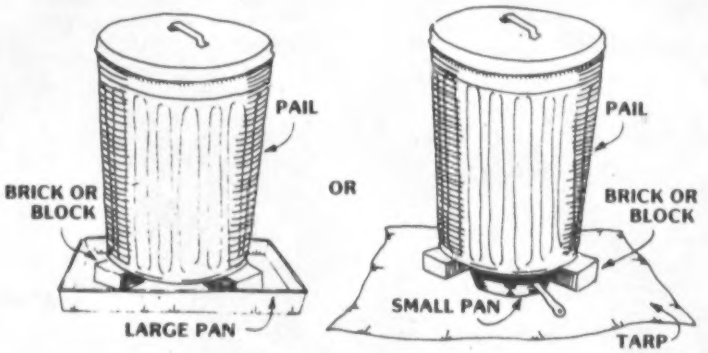
If you don't have an electric drill, have someone do it for you that has one, since this is the quickest and neatest way to make the holes.

2 SET UP THE PAIL

Since this may be a rather messy project, choose a place that won't be bothered by a composter.

Stand the pail on bricks or blocks so that you can collect the organic solution that will run out of the holes in the pail. This solution, also called "Organic Tea" can be diluted with water and used to water plants.

If you find a large enough pan, you can place the pail, bricks and all, into it. If not, set up the composter on a tarp or other suitable covering and catch as much of the "Organic Tea" as you can with any container that will fit under the pail as shown.



3 FILLING THE COMPOSTER

There are 3 kinds of materials to put into the composter:

A) GREEN MATTER (plant wastes, grass, weeds, leaves, hay, straw, kitchen scraps, etc.)

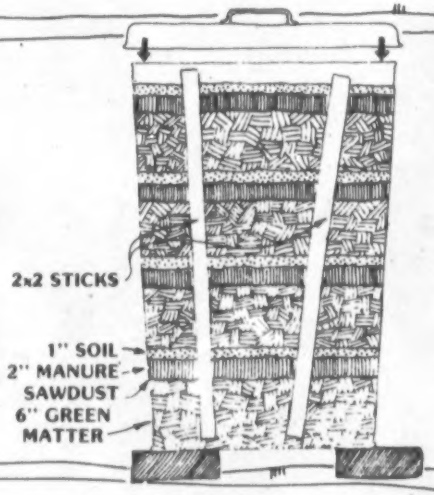
B) MANURE (fish emulsion or bone meal will work)

C) SOIL

Layer these three materials as shown. A thin layer of sawdust after each layer of Green Matter helps to reduce odor and to absorb moisture.

Place two sticks upright into the pail as shown, while filling. Chop and shred the material as much as possible to speed up the composting process.

When filled, take out the sticks (for aeration) and put the lid on.



4 COMPOST MAINTENANCE

Stir the pile once a week for aeration of the compost. It should be very hot in the center.

Keep the pile glistening moist like a sponge.

Compost should be ready in 6-8 weeks.

A successful compost has a crumbly texture, a black-brown color and earth-like odor.

An unsuccessful compost is tight, packed or lumpy, greyish yellow (dead earth) and smells musty (mouldy) or sour (too wet and dry).

Organic Gardening

Organic gardening is a method of gardening that utilizes only naturally occurring materials in the food growing process. The organic gardener imitates the cycles of nature, trying not to disturb the tenuous balance of life in the soil. The soil is enriched by composting, mulching, crop-rotation and other methods that fully utilize natural processes.

A **compost** is a mixture of decomposed organic materials that can be added to soil as a natural, balanced fertilizer. Through composting we are able to return organic wastes back to their source, the soil.

Mulch is a ground covering for soil. An organic mulch, such as grass clippings, straw or newspaper, is placed on the ground around plants to 1) keep weeds down, 2) retain moisture, 3) help maintain a more constant soil temperature, 4) prevent compaction of the soil, and 5) fertilize the soil (over the long term). Various inorganic materials also can be used as a mulch like the organic mulches. A commonly used inorganic mulch is black plastic similar to the plastic used in garbage bags.

Why Organic Fertilizers?

1. **Most organic fertilizers are made of renewable resources. Examples include: livestock manure, grass cuttings, fish emulsion and bone meal.**
2. **Because they are naturally occuring elements, organic fertilizers do not contribute to pollution of waterways or other parts of the environment.**
3. **Organic fertilizers enrich the soil naturally and add to its organic base.**
4. **Most organic fertilizers contribute to a more direct food chain because organic matter is placed directly on the soil and breaks down there.**

Making a Compost

What You Need:

1. Organic Materials: There are an indefinite number of organic materials available in the country as well as in the city if we use our imaginations and seek them out. Some examples: weeds, grass clippings, kitchen garbage (no meat or citrus fruit, please), leaves, human hair, sawdust, ashes (in thin layers), coffee grounds, fish emulsion, manure, crop spoilage or surplus.

2. Proper Decomposition Conditions: Bacteria and fungi are the primary decomposers that convert the individual organic wastes into rich, homogenous humus.

3. Three Conditions are Necessary: air, moisture and warmth.

Layering of Compost:

A compost pile can be built in a contained area (such as a garbage pail or bin) or as a free-standing heap. The optimum dimension for an outside compost heap is a 5'x5'x5' cube, but similar proportional dimensions will work as well. There are many ways of building a compost pile, but for our purposes here, we will look at the free-standing layered cube.

This compost pile has three basic layers that are put down alternately in 2-4 inch layers until the pile reaches the desired size.

Plant Matter is any plant waste or product, such as weeds, kitchen garbage, leaves, corn husks, hay, straw, sawdust, wood chips. Each one of these layers should be about three times as thick as the manure layers.

Manure comes from any farm or ranch animal. Chicken or rabbit manure is extremely good for a compost. The manure can range from very fresh to well-aged or rotting. If it is difficult for you to find manure, you may add or substitute bone meal, blood meal, fish emulsion or other natural fertilizers.

Soil is a thin layer of soil at the top to retain moisture and seal the pile. Soil also can be sprinkled between the layers. Soil serves as a catalyst in decomposition.

Enrichments such as rock phosphate, granite dust, wood ash and limestone will speed up bio-chemical changes in the compost and can be sprinkled between the layers to enrich the pile.

* Meat will attract animals and can putrefy; citrus skins often are treated with fungicides which impede beneficial fungal activity.

Composting tips:

Preparing Material: To speed up the composting process, it is a good idea to chop or shred materials as fine as possible. It will increase the surface area as well as allow for better aeration of the heap. The compost should be about as moist as a well wrung-out sponge. If you are in a rainy area, cover the top of the pile with a tarp. If you are in a dry area make your pile in the shade.

Airing Your Pile: It is important to have air circulating in the heap. The primary method of aerating is to periodically turn the heap. Other methods include placing tubes in the heap as you build it; using an open lattice framework (i.e., chicken wire); or punching holes in the bottom of the compost container.

Heat in the Center: Your pile should become very hot at the center (over 100° F.) because the bacteria and fungi are breaking down the various materials into rich organic humus. When you turn the heap, you are putting the cooler outside materials in touch with the central core of activity so that all the compost becomes homogenous.

Worms for a Healthy Soil: Adding worms to your compost pile will speed up the process; 1,000 to 2,000 worms will soon become 10,000. They mix, aerate and add their excreta to the ingredients of the compost. Worms are very important to a healthy, fertile soil; but don't add the worms until the pile has cooled somewhat!

Successful Compost

crumbly texture
black-brown color
earthlike odor
successful compost will not have an unpleasant odor.

Unsuccessful Compost

tight, packed or lumpy
grayish-yellowish; too much dead earth
musty smells; molds
sour smell; too wet, not enough air
unchanged materials; too dry

In making compost the organic gardener is trying to duplicate the cycles of life and death which take place in the soil. If we did not harvest any crop or interfere in any way, the recycling of nutrients would take place by itself. We do, however, take very substantial crops from the land, so it is necessary to return what we can – our waste. All the plant and animal products that originate from the soil can be returned to the soil, completing the circle and keeping the system healthy and productive.

Other Organic Fertilizers

Many of the ingredients of compost can be used separately as fertilizers. You may work them into the soil, lay them down as mulch, or simply apply them around growing plants as a side dressing. These materials should be used whenever you wish to improve the fertility of the soil or give your plants a boost. Some examples:

Bone Meal is crushed bone which comes in powder form. This can be sprinkled around growing vegetables as a side dressing.

Blood Meal is dried blood in powder form. This is very high in nitrogen (12-15 percent) and should be sprinkled sparingly.

Fish Emulsion is a liquid fertilizer made from fish and fish by-products. A capful should be diluted in one gallon of water and poured around plants. This is a good source of nitrogen and phosphorous.

Granite Dust is a very good source of potash and can be added directly to the soil or as a side dressing.

Rock Phosphate is a powder made from crushed rock, high in phosphorous, calcium, iron, sodium, magnesium, boron and iodine. Good directly in soil and as a side dressing.

Wood Ash can be used to add alkalinity to soil or compost. It makes a very good mulch and is a good source of phosphorous and potash.

Manure is a very important component in compost and can be used directly in soil as well. Cow, horse, goat, pig, chicken, sheep and pigeon are all possible sources of manure for the organic gardener. Dried manure is always richer in nutrients than fresh, but often it is easier to obtain a fresh source and the rule should be: choose the materials which are easily obtainable in your area at a minimum cost. *One precaution:* Fresh manure or manure which has not been aged may burn your plants and should be used with discretion as a mulch only. Apply it to the soil in the autumn or use it in the compost pile.

Green Manure is a crop grown specifically for soil improvement, especially legumes such as clover. The plants can be turned under, used as mulch or layered in the compost.

1. Most organic fertilizers are made of renewable resources. Examples include: livestock manure, grass cutting, fish emulsion and bone meal.

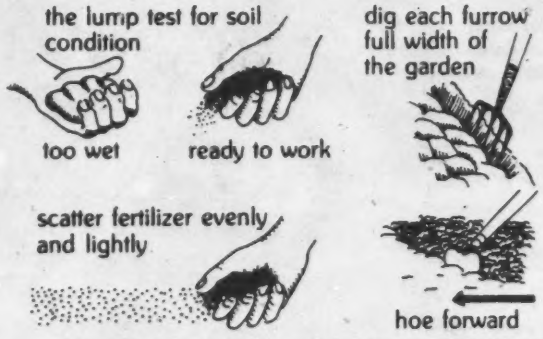
2. Because they are naturally occurring elements, organic fertilizers do not contribute to pollution of waterways and other parts of the environment.

3. Organic fertilizers enrich the soil naturally and add to its organic base.

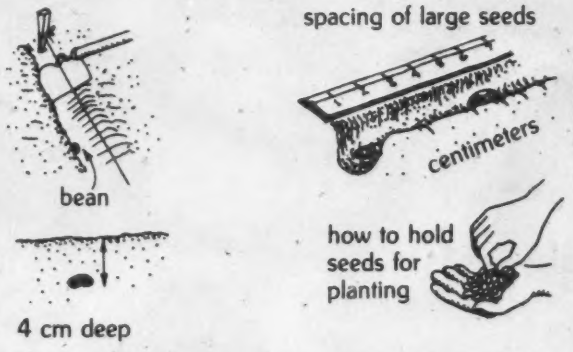
4. Most organic fertilizers contribute to a more direct food chaine because organic matter is placed directly on the soil and breaks down there.

TIPS FOR A SUCCESSFUL GARDEN

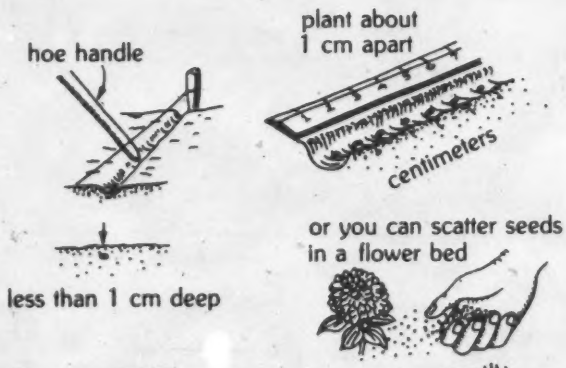
1 DIGGING AND FERTILIZING THE GROUND OF THE PLANTING PLACES


the lump test for soil condition
too wet
ready to work
dig each furrow full width of the garden
scatter fertilizer evenly and lightly
hoe forward

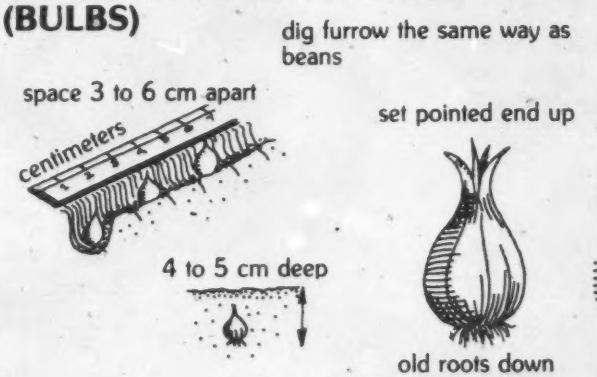
2 PLANTING GREEN BEAN SEEDS



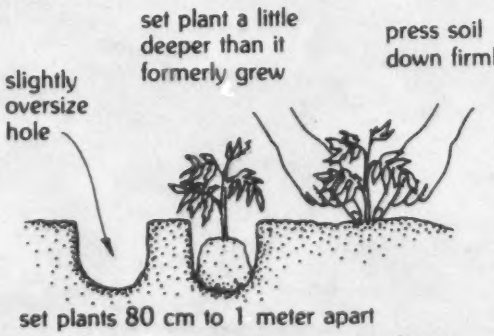
3 PLANTING ZINNIA SEEDS



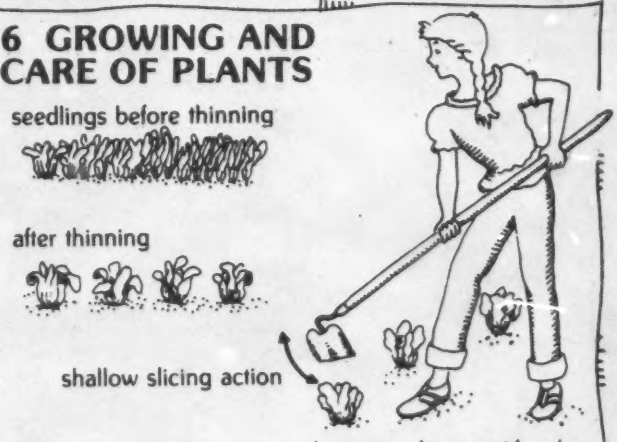
4 PLANTING ONION SETS (BULBS)



5 PLANTING THE TOMATO PLANT


set plant a little deeper than it formerly grew
press soil down firmly
slightly oversize hole
set plants 80 cm to 1 meter apart

6 GROWING AND CARE OF PLANTS



* *From Cleveland Public Schools, Horticulture Department.*

MY TOWN'S ENERGY CONCERNS

69

ACTIVITY:

The teacher will ask the students questions such as:

How is your home heated?
Where does the electricity that services your house come from?
How does that power plant generate electricity?
What kind of fuel is necessary to heat the building where your mother, father, works?

Students will search local newspapers for energy-related articles. Students will examine articles looking for answers to questions such as:

How did the newspaper handle energy-related problems?
What sources of energy did the articles note?
Where does our town get its fuel supply?
How is our town's fuel transported to us?
What are the major energy problems in your community?
How has our town handled these problems?
How do energy problems in our town compare with those in other parts of the country?

Invite a representative of an environmental group, government agency, and/or local power company to speak about community energy problems. Thoughtful questions should be listed ahead of time.

Students will follow-up this activity by completing one of the following assignments:

Write an essay or produce for the class an interview following a TV format on one of the suggested titles: "How the Energy Crisis Has Affected Our Town", "What are the Benefits as a Result of the Energy Crisis", "Our Town's Energy Problems", or choose a title of your own.

List the new things they learned through these exercises.

CONCEPT:
Various energy sources have differing impacts on the environment.

SUBJECT:
Social Studies
Science

MATERIALS:
Research materials, Newspapers, etc.

WHO USES WHAT

70

ACTIVITY:

Teacher Preparation:

Duplicate inventory sheet for each student. Instruct the student to interview the people on their block to find the kinds of energy used for heating, cooking, etc.

The next class period discuss the kinds, uses, and quantity. A large poster may be made to show compilation of data. Discuss related topics such as depletion, supply and demand, and impacts.

CONCEPT:
To explore ways people in the community use energy.

SUBJECT:
Social Studies

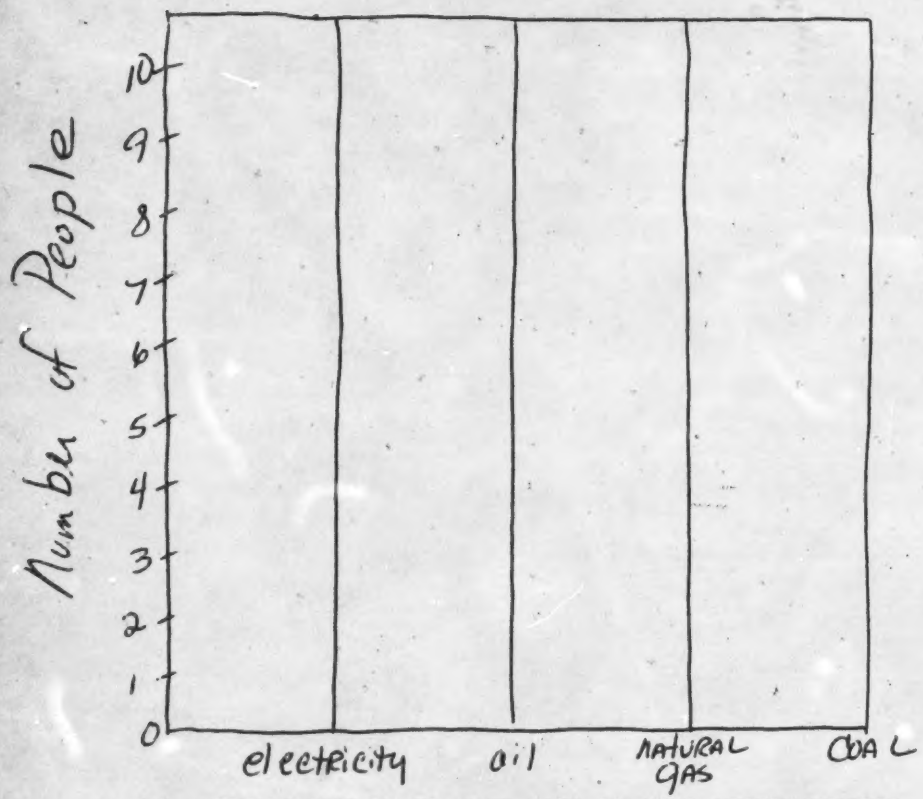
MATERIALS:

Per student:
Inventory sheet
Pencil

COMMUNITY INVENTORY SHEET

INVENTORY YOUR HOME BLOCK TO FIND THE KINDS OF ENERGY FOR HEATING, COOKING, AIR CONDITIONING, ETC. ANSWER THE QUESTIONS AND COMPLETE THE BAR GRAPH.

INVENTORY DATA SHEET



NUMBER OF PEOPLE USING ELECTRICITY_____

NUMBER OF PEOPLE USING NATURAL GAS _____

NUMBER OF PEOPLE USING OIL _____

NUMBER OF PEOPLE USING COAL _____

WHICH KIND OF ENERGY IS MOST USED IN YOUR NEIGHBORHOOD? _____

WHERE WERE YOU WHEN THE LIGHTS WERE OUT?

71

ACTIVITY:

First Day:

1. Assign students roles in a make believe community such as: mayor, police chief, fire chief, father, business man, etc.
2. Get together in small groups and let them discuss how energy affects the particular role them were assigned.

Second Day:

3. Diaster hits!! Black out!! The lights are out and turn on tape recorder (explained later).
4. After first part of tape is over have them resume their community roles. In doing so they act out their community roles in regard to the black out. While doing so they try to decide what roles need more energy and what roles can get by with the least.
5. The teacher could add simulated problems that concern specific roles in the community. Example: A patient is on a kidney machine that requires electricity.

6. After discussion, play Part II of tape.

7. The teacher should brainstorm with the students and they should decide what community roles should be allowed to use the limited amount of energy.

TAPE

First part:

Attention community members: We are now faced with an energy shortage. Due to an unusually high energy demand our electrical transformers are overloaded and we will be without electricity for an unknown period. Officials are working to relieve the situation. Please stay calm and function as normally as possible during the crisis.

Second part:

Citizens: We have a limited amount of energy available. Resume activities to a minimal basis.

Third part:

Students, the transformers have resumed full capacity. You may resume your usual routine. Thank you.

CONCEPT:
All resources are limited

SUBJECT:

Social studies

MATERIALS:

Tape
Tape recorder

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TRANSPORTATION GAME

72

ACTIVITY:

Teacher preparation:

Cut small squares of tagboard. Print the following words on the tagboard squares:

Indian	Eskimo
Viking	snow
ice	sailor
child	Pilgrim
soldier	astronaut
pilot	mail
underground	school
shoes	parents
balloon	desert

Place the tagboard squares in an envelope. Print these directio on the envelope:

Shuffle the word cards. Number a piece of writing paper from one to eighteen. Set the kitchen timer for five minutes. Draw a card and read the word. Write the means of transportation that the word suggests. (EXAMPLE: engineer - train) Continue until all the word cards have been used. Record the amount of time it took for the activity.

CONCEPT:

To identify the various modes of transportation

SUBJECT:

Social Studies
Language Arts

MATERIALS:

Envelopes
4 x 6 inch tagboard (20 pieces)
Paper
Pencil
Timer

TRANSPORTATION, YESTERDAY AND TODAY

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ACTIVITY:

Teacher preparation: Make a task card of a ship

Draw and cut out a cardboard ship. Print these directions on it:

> The Department of Transportation has commissioned you to create a mural depicting the history of transportation. The mural will be displayed in the school lobby. Use colored chalk to draw the mural.

Upon completion of the mural discuss sources of energy required for changes in modes of transportation.

CONCEPT:

To identify various modes of transportation

SUBJECT:

Social Studies
Art

MATERIALS:

Mural paper
Crayons

HOW MUCH DOES TRANSPORTATION COST?

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ACTIVITY:

Duplicate the following math problems for your students to solve.

Imagine there are 30 people who are taking a shott trip to town. The total distance, coming and going, for the trip is five miles. Each of these people owns a car that goes 20 miles on one gallon of gas. A gallon of gas cost $1.30.

If each person drives alone on the five mile trip, what is the total amount of gasoline that would be used?

How much would the gasoline for the 30 separate trips cost?

How much gas would each person use?

Let's say only half the cars made the trip to town. Two people riding in each car to save gas. How much gasoline would be used in 10 trips?
How much would the gas cost?
How much gas in total would be used?

What if four people decided to go in one car. How much gasoline would be used in one trip? (At 4 people in 5 cars)
How much would it cost?
How much would each person spend if they combined their efforts as opposed to each one driving separately?

CONCEPT:
To calculate the cost of the advantages of carpooling over single driving

SUBJECT:
Math

MATERIALS:
Per student:

Pencil
Math problems

AUTOSAUR

75

ACTIVITY:

Read to the class the following:

This is the year 3000. An Arizona newswriter has released a startling news story. He repo ts that during the 20th century earth was inhabited by huge metallic-looking beasts called "autosaurs". These monsters weighed between 1,000 and 4,000 pounds and could travel at terrific rates of speed. Although they could be ridden, they were never completely comesticated by the natives. Apparently thousands of natives lost their lives from them each year.

Around the last few decades of the century, he tells us the "autosaurs" mysteriously disappeared. Scientists believed they "starved" to death because of their depletion of food supply. A picture from a LosAngeles newspaper shows these creatures lined up before a feeding station. One of the natives if forced to feed the creatures by a means of a hose. This effort evidently was unsuccessful.

Conclusion: Although the extinction of any species is mourned, it does not appear that the ecological balance of that period was upset by the "autosaurs" disappearance. There was proof that it was even was improved.

Discussion:

Does the name "autosaur" relate to any type of invention we use today?

Do you think this could bery well be possible in the future?

If the planet was improved by the disappearing of the "autosaur" how would you explain this advantage?

Make posters of different sizes of "autosaurs" that may have been found. Display around the room and have students explain how much "food supply" did it use and which do they think died out first. Why?

CONCEPT:
The shortage of some of our natural may be beneficial to the earth's existence.

SUBJECT:
Social studies
Language Arts

MATERIALS:
Drawing paper
Scissors
Glue

ENERGY IN YOUR SCHOOL

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ACTIVITY:

There are two key ideas about energy products and how they are used. One type of energy produce is that which uses energy such as dishwashers and refridgerators. The other type of energy product is that which is made from an energy source of is made using energy sources. Tables are made from wood, clay pots are made using heat.

Make a chart with the heading Energy Product. Have students list:
a)all the things in the classroom that use energy.
b)all the things that were made from energy sources.

Ask the students to do a scavenger hunt in their classroom, playground, or school. Have them describe the energy products which they find that are examples of non-human energy.

Have students make a diorama of energy products in their class. Have them talk about their dioramas with the class.

MATH ADAPTATION:

Ask students to go out on the playground and count the number of human and non-human energy sources that they find.

Have students take one day in their lives and count and compare the number of energy products they use.

CONCEPT:
Energy can be defined as the ability to heat, light and move things.

SUBJECT:

Language Arts
Math

MATERIALS:

SCAVENGER ENERGY HUNT

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ACTIVITY:

You may ask your students to find individually the answers to these questions or you may do this as a class activity.

Go outside and find:

Stored energy in you school yard.

Something that gives off heat.

Something that moves by the wind.

Something made from wood.

Something hot.

Something cold.

Something that can be recycled.

2 Things that use electricity.

2 Different types of body power that are being used during this hunt.

Something that uses solar energy.

A "natural" hitchhiker. (Example would be seeds such as burs or parasites like ticks)

CONCEPT:
To explore different energy sources & uses.

SUBJECT:

Language Arts
Science

MATERIALS:

List of Scavenger Hunt items per student

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